User's Guide to CLShanCommands

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I wrote this User's Guide to help you to understand my `\newcommand`s system in the `CLShanCommands-Math.tex` and the `CLShanCommands-Beamer.tex` files and to use them conveniently. You can just take my definitions of these `\newcommand`s, if you like them. On the other hand, if you have some better ideas, you can also modify some of my definitions to your favorite style. Meanwhile, if you want, please share me your good ideas.

For `Version 2.1`, I added a few new `\newcommand`s in the `CLShanCommands-Math.tex` file (see Sections 2.3 and 2.15). Furthermore, I rewrote the `CLShanCommands-Math.tex` and the `CLShanCommands-Beamer.tex` files to two `packages`: the `clshan-math.sty` and the `clshan-beamer.sty` files. This means that you have now two choices to use my `\newcommand`s. You can copy or link two `.tex` files in the dictionary in which you work and input or include them to your own files. But, if you use LaTeX 2$_\varepsilon$ instead of LaTeX (you use `\documentclass` instead of `\documentstyle` in the first line of your files), it should be a better and more convenient way to use the `\usepackage{clshan-math}` and `\usepackage{clshan-beamer}` commands. If you use `MiKTeX` to compile your .tex files, you can put the `clshan-math.sty` and the `clshan-beamer.sty` files in the, for example, `C:\MiKTeX\tex\latex\clshan\` dictionary, and then open the `MiKTeX Options` in the `Accessories` in the `Toolbar` to `Refresh` the `Files name database`. Then you can use the `\usepackage{clshan-math}` and `\usepackage{clshan-beamer}` commands directly.

For `Version 3.0`, I added more new `\newcommand`s in the `CLShanCommands-Math.tex` file (see Sections 1.3, 1.4, and 2.14). Meanwhile, in order to use these `\newcommand`s in the `beamer` class, I redefined the `\newcommand`s in Section 1.3 in the `CLShanCommands-Beamer.tex` file (detail see Section 5.2).

For `Version 3.1`, I added a few `\newcommand`s in Section 2.3.

In `Version 4.0`, I completed my "a-b-c-v-n-s" and "A-B-C-V-N" systems for brackets, absolute values, and norms in Section 2.3, for differentiations in Section 2.6, for partial differentiations in Section 2.7, and for the operators involving ∇ in Section 2.8. On the other hand, I modified my definitions for the atomic symbols in Section 2.11.

In `Version 4.1`, I corrected some of my `\newcommand`s for changing equation numbers in section 1.4.

In `Version 4.2`, I added two `\newcommand`s for changing equation numbers in section 1.4.

Finally, if you find this **User's Guide to CLShanCommands** too thick to read (since the `Version 4.0` it is already more than one hundred pages) and want just a quick view of my `\newcommand`s and their examples, it is convenient for you to use my `CLShanCmds-Examples-Math.tex` or `CLShanCmds-Examples-Math.pdf` files for my mathematical symbols in Section 2, and my `CLShanCmds-Examples-Matrix.tex` or `CLShanCmds-Examples-Matrix.pdf` files for the matrices in Section 3.

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†Fresh defined `\newcommand`s

1 Abbreviations

I defined some abbreviations for the long commands which have been used very often.

1.1 `displaystyle` or `textstyle`

Sometimes I want to use `\textstyle` in a equation to reduce the size of some big parts of this equation such like:

$$\left[\frac{\sinh^2\left(2\widetilde{K}_{\mathrm{G}}\right)}{2\sqrt{\widetilde{K}_{\mathrm{G}}}}\right]$$

to

$$\left[\frac{\sinh^2\left(2\widetilde{K}_{\mathrm{G}}\right)}{2\sqrt{\widetilde{K}_{\mathrm{G}}}}\right]$$

and sometimes I want to use `\displaystyle` in a `table` or an `array` environment to remain the size of some elements, for example,

$$\left\{\begin{array}{rcl} a & = & \frac{3}{25} \\ b & = & 2 \end{array}\right.$$

as

$$\left\{\begin{array}{rcl} a & = & \displaystyle\frac{3}{25} \\ b & = & 2 \end{array}\right.$$

I'm lazy to type a long command and it is also easy to make a typing mistake. Hence, I defined two abbreviations for them:

Definitions

```
\newcommand{\D}                 {\displaystyle}
\newcommand{\T}                 {\textstyle}
```

1.2 `equation` and `eqnarray` environments

For the `equation` and `eqnarray` environments with equation numbers, I defined the following abbreviations:

Definitions

```
\newcommand{\beq}               {\begin{equation}}
\newcommand{\eeq}               {\end{equation}  }
```

```
\newcommand{\beqn}              {\begin{eqnarray}}
\newcommand{\eeqn}              {\end{eqnarray}  }
```

On the other hand, for cases without equation numbers, I added an "N" to indicate "no number":

Definitions

```
\newcommand{\beqN}              {\[              }
\newcommand{\eeqN}              {\]              }
```

```
\newcommand{\beqnN}             {\begin{eqnarray*}}

\newcommand{\eeqnN}             {\end{eqnarray*}  }
```

It seems a little more complicated to define longer commands for `\[` and `\]`. But, sometimes I used the `equation` environment at first and then found that there are too many equation numbers. I decided to reduce the number of `equation` and deleted some couples of `\begin{equation}` and `\end{equation}` and replace them to `\[` and `\]`. However, I found later that I have deleted some equation numbers which I actually need. So I must invert the above process: delete some couples of `\[` and `\]` and then replace them to `\begin{equation}` and `\end{equation}`. It is too tired and seems stupid. Hence, I defined these two commands for `\[` and `\]`. Then I just need to delete or add an N! Moreover, I defined

Definition

```
\newcommand{\non}               {\nonumber}
```

and

Definitions

```
\renewcommand{\&}               {& \hspace{-1.3ex}}

\renewcommand{\=}               {& \hspace{-1.3ex} = & \hspace{-1.3ex}}
```

for the `eqnarray` environment. Because the space on the both sides of the "=" sign in the `eqnarray` environment is too large and I want that they have the same width as in the `equation` environment. Furthermore, I defined

Definition

```
\renewcommand{\~}               {~\!}
```

for a smaller space than `~`. Note here that I *redefined* these three commands (the only three commands which I redefined) `\&`, `\=`, and `\~` (their original definitions are &, ā, and ã). But, I thought that it is pretty natural to use such names for the `\newcommand`s which have been considered to replace the commands: `&`, `&=&`, and `~`. On the other hand, I use their original definitions in fact very seldom. Thus these definitions are very convenient for me, and, when I need to type &, ā, and ã (like here), I can use the following replacements:

Symbols	Original commands in LaTeX	My replacements
&	`\&`	`\symbol{'46}`
ā	`\={a}`	`$\bar{\rm a}$`
ã	`\~{a}`	`$\tilde{\rm a}$`

Finally, I defined an abbreviation for writing my note conveniently:

Definition

```
\newcommand{\then}              {\Longrightarrow ~~}
```

Example

```
    \Longrightarrow          \then
```

Below I give you an example to show you how to combine these `\newcommand`s.

Example

```
\beqn
\then
              \sin x
 \=           \sum_{k=0}^{\infty} \frac{(-1)^{k} \~ x^{2k+1}}{(2k+1)!}
              \non\\
 \&\approx\&  x-\frac{x^3}{6}+\frac{x^5}{120}
\eeqn
```

$$\begin{aligned} \Longrightarrow \quad \sin x &= \sum_{k=0}^{\infty} \frac{(-1)^k \, x^{2k+1}}{(2k+1)!} \\ &\approx x - \frac{x^3}{6} + \frac{x^5}{120} \end{aligned} \tag{1}$$

1.3 More `\newcommand`s for the `eqnarray` environment

At first I redefined the `\&` command in LaTeX (see Section 1.2) in order to reduce the default space when we use an `&` in the `eqnarray` environment. Then I redefined the `\=` command for the longer command `\&=\&` because I used it very very often. Due to the convenience of this (re)definition, I decide now to define the following `\newcommand`s for all binary relation which we can use in the `eqnarray` environment:

Definitions

```
\newcommand{\eqnneq}          {& \hspace{-1.3ex} \neq    & \hspace{-1.3ex}}

\newcommand{\eqnne}           {& \hspace{-1.3ex} \ne     & \hspace{-1.3ex}}
```

```
\newcommand{\eqnleq}          {& \hspace{-1.3ex} \leq    & \hspace{-1.3ex}}

\newcommand{\eqnle}           {& \hspace{-1.3ex} \le     & \hspace{-1.3ex}}
```

```
\newcommand{\eqngeq}          {& \hspace{-1.3ex} \geq    & \hspace{-1.3ex}}

\newcommand{\eqnge}           {& \hspace{-1.3ex} \ge     & \hspace{-1.3ex}}
```

```
\newcommand{\eqnll}           {& \hspace{-1.3ex} \ll     & \hspace{-1.3ex}}

\newcommand{\eqngg}           {& \hspace{-1.3ex} \gg     & \hspace{-1.3ex}}
```

```
\newcommand{\eqnequiv}        {& \hspace{-1.3ex} \equiv   & \hspace{-1.3ex}}

\newcommand{\eqndoteq}        {& \hspace{-1.3ex} \doteq   & \hspace{-1.3ex}}
```

```
\newcommand{\eqncong}          {& \hspace{-1.3ex} \cong   & \hspace{-1.3ex}}
\newcommand{\eqnapprox}        {& \hspace{-1.3ex} \approx & \hspace{-1.3ex}}
```

```
\newcommand{\eqnsimeq}         {& \hspace{-1.3ex} \simeq  & \hspace{-1.3ex}}
\newcommand{\eqnsim}           {& \hspace{-1.3ex} \sim    & \hspace{-1.3ex}}
```

```
\newcommand{\eqnpropto}        {& \hspace{-1.3ex} \propto & \hspace{-1.3ex}}
```

where the "eqn" stands for the `"eqn"array` environment. As an example I rewrite the last example in Section 1.2 as following:

Example

```
\beqn
\then
             \sin x
 \=          \sum_{k=0}^{\infty} \frac{(-1)^{k} \~ x^{2k+1}}{(2k+1)!}
             \non\\
 \eqnapprox  x-\frac{x^3}{6}+\frac{x^5}{120}
\eeqn
```

Meanwhile, for a longer equation such like

$$\begin{aligned}\frac{\sinh^2 x - x^2}{x^2\ \sinh^2 x} &= \cdots \\ &= \left(\frac{1}{3}+\frac{2x^2}{45}+\frac{x^4}{315}+\cdots\right) \\ &\quad \times \left[1-x^2\left(\frac{1}{3}+\frac{2x^2}{45}+\frac{x^4}{315}+\cdots\right)+x^4\left(\frac{1}{3}+\frac{2x^2}{45}+\frac{x^4}{315}+\cdots\right)^2-+\cdots\right]\end{aligned}$$

I usually use a command `\&~\&` for the last line. Because I have already used (redefined) the command `\~` for `~\!` (see Section 1.2), I define the following `\newcommand`:

Definition

```
\newcommand{\conti}            {& \hspace{-1.3ex} ~       & \hspace{-1.3ex}}
```

where the "conti" stands for "continue". As an example I give you the commands for the last two lines of the above equation here:

Example

```
\=     \left(......\right)
       \non\\
\conti ~~~~~~ \times
       \left[1-x^2 ......\right]
```

Furthermore, for the case in which you want to put something else instead of a normal binary relation in the `eqnarray` or `eqnarray*` environments, I defined also a `\newcommand` here:

Definition

```
\newcommand{\eqnBinary}    [1]  {& \hspace{-1.3ex} #1      & \hspace{-1.3ex}}
```

Then we can rewrite the three commands which I used as examples above as following:

Examples

```
\=              \eqnBinary{=}

\eqnapprox      \eqnBinary{\approx}

\conti          \eqnBinary{~}
```

1.4 Changing equation numbers †

Sometimes we want to label the equation number of two equations as following:

$$\sin x = \frac{e^{ix} - e^{-ix}}{2i} = x - \frac{x^3}{6} + \frac{x^5}{120} - + \cdots \tag{4a}$$

$$\cos x = \frac{e^{ix} + e^{-ix}}{2} = 1 - \frac{x^2}{2} + \frac{x^4}{24} - + \cdots \tag{4b}$$

Formally, for such cases, we use a command `\renewcommand{\theequation}{\arabic{equation}a}` at first, and then commands `\addtocounter{equation}{-1}` and `\renewcommand{\theequation}{\arabic{equation}b}` between these two equations, finally, we use `\renewcommand{\theequation}{\arabic{equation}}` to change the label of the equation number back. Such a combination is almost fixed and we need it maybe pretty frequently. For sure we can just copy them every time. But I think it is better to define some short `\newcommand`s.

Definitions

```
\newcommand{\cheqn}             {\renewcommand{\theequation}{\arabic{equation}}}
\newcommand{\cheqnx}       [1]  {\renewcommand{\theequation}{\arabic{equation}#1}}
```

```
\newcommand{\cheqnN}       [1]  {\addtocounter{equation}{#1}
                                  \renewcommand{\theequation}{\arabic{equation}}}
\newcommand{\cheqnNx}      [2]  {\addtocounter{equation}{#1}
                                  \renewcommand{\theequation}{\arabic{equation}#2}}
```

Here the "ch" "eq" "n" stand for "change" "equation" "number", with an "x" means you want to add something after the number, for example a and b above, with an "N" means you want to change the equation number before the Roman letter. Meanwhile, because we usually use a, b, and/or c after the number, I defined directly the following `\newcommand`s for them:

Definitions

```
\newcommand{\cheqna}            {\renewcommand{\theequation}{\arabic{equation}a}}
\newcommand{\cheqnb}            {\addtocounter{equation}{-1}
                                  \renewcommand{\theequation}{\arabic{equation}b}}
\newcommand{\cheqnc}            {\addtocounter{equation}{-1}
                                  \renewcommand{\theequation}{\arabic{equation}c}}
```

† Fresh defined `\newcommand`s

Then, for the two equations above, I just need the following three simple commands:

Examples

```
\cheqnNx{3}{a}
\cheqnb
\cheqn
```

On the other hand, if you want to label the equation number like

$$\sin x = \frac{e^{ix} - e^{-ix}}{2i} = x - \frac{x^3}{6} + \frac{x^5}{120} - + \cdots \tag{def 4a}$$

$$\cos x = \frac{e^{ix} + e^{-ix}}{2} = 1 - \frac{x^2}{2} + \frac{x^4}{24} - + \cdots \tag{def 4b}$$

I have also defined some `\newcommand`s for such cases:

Definitions

```
\newcommand{\cheqnX}       [1]  {\renewcommand{\theequation}{#1\arabic{equation}}}
\newcommand{\cheqnXx}      [2]  {\renewcommand{\theequation}{#1\arabic{equation}#2}}
```

```
\newcommand{\cheqnXN}      [2]  {\addtocounter{equation}{#2}
                                  \renewcommand{\theequation}{#1\arabic{equation}}}
\newcommand{\cheqnXNx}     [3]  {\addtocounter{equation}{#2}
                                  \renewcommand{\theequation}{#1\arabic{equation}#3}}
```

```
\newcommand{\cheqnXa}      [1]  {\renewcommand{\theequation}{#1\arabic{equation}a}}
\newcommand{\cheqnXb}      [1]  {\addtocounter{equation}{-1}
                                  \renewcommand{\theequation}{#1\arabic{equation}b}}
\newcommand{\cheqnXc}      [1]  {\addtocounter{equation}{-1}
                                  \renewcommand{\theequation}{#1\arabic{equation}c}}
```

where the "X" indicates that you can (have to) give a name for these equations, for example the "def" above. Note here that whether there the "X" "N" and "x" is and their order in these `\newcommand`s can remind you how to give the parameters. For the two equations above, I can use the following three commands:

Examples

```
\cheqnXNx{def }{3}{a}
\cheqnXb{def }
\cheqnX{def }
```

Because we usually use the commands `\cheqn` and `\cheqnX` to change the label of the equation number back, I also gave each of them an other name:

Definitions

```
\newcommand{\reeqn}              {\renewcommand{\theequation}{\arabic{equation}}}

\newcommand{\reeqnX}       [1]  {\renewcommand{\theequation}{#1\arabic{equation}}}
```

where the "re" stands for "return". Then the two examples above can be rewritten as

Examples

```
\cheqnNx{3}{a}
\cheqnb
\reeqn
```

```
\cheqnXNx{def }{3}{a}
\cheqnXb{def }
\reeqnX{def }
```

Finally, sometimes we label an equation and use it later:

$$\sin x = x - \frac{x^3}{6} + \frac{x^5}{120} + - \cdots \tag{4a}$$

or, sometimes we change this equation a little bit:

$$\sin x \approx 1 - \frac{x^3}{6} + \frac{x^5}{120} \tag{4a'}$$

Hence I defined the following three `\newcommand`s:

Definitions

```
\newcommand{\cheqnref}     [1]  {\renewcommand{\theequation}{\ref{#1}}}
\newcommand{\cheqnrefp}    [1]  {\renewcommand{\theequation}{\ref{#1}'}}
\newcommand{\cheqnrefdp}   [1]  {\renewcommand{\theequation}{\ref{#1}''}}
```

where the "ref" stands for the LaTeX command `\ref`, "p" stands for "prime", and "dp" stands for "double prime". For the second equation above, I can use the following two commands:

Examples

```
\cheqnrefp{04a}
\cheqnN{-1}
```

Note that I used `\cheqnN` above in order to correct the "counter" of the equation number.

1.5 Suggestions for the `equation` and `eqnarray` environments

In this and the next section, I will suggest you some convenient definitions of `\newcommand`s, but, please note that they are *not defined* in my `CLShanCommands-Math.tex` file. If you need them pretty often, you can certainly add them into my file or your own `\newcommand`s-file.
First, some people prefer to use shorter commands for the `equation`, `eqnarray`, and `eqnarray*` environment:

Definitions

```
\newcommand{\be}                {\begin{equation} }
\newcommand{\ee}                {\end{equation}   }
```

```
\newcommand{\beq}               {\begin{eqnarray} }
\newcommand{\eeq}               {\end{eqnarray}   }
```

```
\newcommand{\beqn}              {\begin{eqnarray*}}
\newcommand{\eeqn}              {\end{eqnarray*}  }
```

Actually, you can use the following commands to reduce each pair commands for one environment to just one:

Definitions

```
\newcommand{\eqin}         [1]  {\begin{equation}  #1 \end{equation} }
\newcommand{\eqnin}        [1]  {\begin{eqnarray}  #1 \end{eqnarray} }
\newcommand{\eqNin}        [1]  {\begin{eqnarray*} #1 \end{eqnarray*}}
```

Furthermore, if you label your equations very often, then the following commands seem very convenient for you:

Definitions

```
\newcommand{\eqlabel}      [2]  {\begin{equation} #1 \label{eqn#2} \end{equation}}
\newcommand{\eqnlabel}     [2]  {\begin{eqnarray} #1 \label{eqn#2} \end{eqnarray}}
```

Example

```
\eqnlabel{
\then
              \sin x
 \=           \sum_{k=0}^{\infty} \frac{(-1)^{k} \~ x^{2k+1}}{(2k+1)!}
              \non\\
 \&\approx\&  x-\frac{x^3}{6}
}
{203}
```

1.6 Suggestions for the `figure` and `table` environments

Similar to my Suggestions for the `equation` and `eqnarray` environments, you can use

Definitions

```
\newcommand{\bfig}              {\begin{figure} }
\newcommand{\efig}              {\end{figure}   }
```

```
\newcommand{\bfigs}             {\begin{figure*}}
\newcommand{\efigs}             {\end{figure*}  }
```

for the `figure` and `figure*` environments, and

Definitions

```
\newcommand{\btab}              {\begin{table} }
\newcommand{\etab}              {\end{table}   }
```

```
\newcommand{\btabs}             {\begin{table*}}
\newcommand{\etabs}             {\end{table*}  }
```

for the `table` and `table*` environments. Note that the "s" in the above commands stands for "star ($*$)". On the other hand, you can also define just one command for an environment:

Definitions

```
\newcommand{\figin}        [1]  {\begin{figure}  #1 \end{figure} }
\newcommand{\figsin}       [1]  {\begin{figure*} #1 \end{figure*}}
```

```
\newcommand{\tabin}        [1]  {\begin{table}   #1 \end{table}  }
\newcommand{\tabsin}       [1]  {\begin{table*}  #1 \end{table*} }
```

Moreover, you can also combine the `\label` command as following:

Definitions

```
\newcommand{\figlabel}     [2]  {\begin{figure } #1 \label{fig#2} \end{figure }}
\newcommand{\figslabel}    [2]  {\begin{figure*} #1 \label{fig#2} \end{figure*}}
```

```
\newcommand{\tablabel}     [2]  {\begin{table}   #1 \label{tab#2} \end{table}  }
\newcommand{\tabslabel}    [2]  {\begin{table*}  #1 \label{tab#2} \end{table*} }
```

or, even also combine the `\caption` command:

Definitions

```
\newcommand{\figlabelcap}  [3]  {\begin{figure}  #1 \label{fig#2} \caption{#3} \end{figure} }
\newcommand{\figslabelcap} [3]  {\begin{figure*} #1 \label{fig#2} \caption{#3} \end{figure*}}
```

```
\newcommand{\tablabelcap}  [3]  {\begin{table}   #1 \label{tab#2} \caption{#3} \end{table}  }
\newcommand{\tabslabelcap} [3]  {\begin{table*}  #1 \label{tab#2} \caption{#3} \end{table*} }
```

Example

```
\figlabelcap{
[p]
\begin{center}
\begin{picture}(10,10)
\put(2,2){\framebox(6,6){Sample}}
\end{picture}
\end{center}
}
{2a}
{A sample picture.}
```

2 Mathematical Symbols

I defined pretty lots of `\newcommand`s for long series of commands which I used very often. I will give you my new commands, explain their names (to help you better to remember these commands). I will also give you examples for these `\newcommand`s.

2.1 Special functions

Some special functions have not been defined in LaTeX, e.g., `\sech` or `\csch`. I defined a part of them (not all of them!) when I had to use such functions. First, the two hyperbolic functions mentioned above have been defined as following, respectively:

Definitions

```
\newcommand{\sech}              {{\rm sech}                          }
\newcommand{\sechx}        [1]  {{\rm sech}      \hspace{0.375ex} #1}
\newcommand{\sechn}        [1]  {{\rm sech^{#1}}                      }
\newcommand{\sechnx}       [2]  {{\rm sech^{#1}} \hspace{0.385ex} #2}
```

```
\newcommand{\csch}              {{\rm csch}                          }
\newcommand{\cschx}        [1]  {{\rm csch}      \hspace{0.375ex} #1}
\newcommand{\cschn}        [1]  {{\rm csch^{#1}}                      }
\newcommand{\cschnx}       [2]  {{\rm csch^{#1}} \hspace{0.385ex} #2}
```

Here I defined two commands `\sech` and `\sechx` for sech function. Because, for the other LaTeX defined special functions, the space between the function, sech, and the argument such like x is a little bigger than that between sech and the argument, for example, (x). Meanwhile, I also defined two commands `\sechn` and `\sechnx` for powers of the sech function, because we also need an a little bigger space between sech^2 and x than (x). Moreover, if we use a command such like `\sechx{^2 x}`, than we will get $\mathrm{sech}\,^2x$, the space stands between the function sech and the power 2, not what we want: between the function with the power 2, sech^2 and the argument x. Below I give you examples for every defined commands above to let you understand the differences.

Examples

$\operatorname{sech} x$	`\sechx{x}`
$\operatorname{sech}(x)$	`\sech(x)`
$\operatorname{sech}^{\mathrm{k}} x$	`\sechnx{k}{x}`
$\operatorname{sech}^{\mathrm{k}}(x)$	`\sechn{k}(x)`

$\operatorname{csch} x$	`\cschx{x}`
$\operatorname{csch}(x)$	`\csch(x)`
$\operatorname{csch}^{\mathrm{k}} x$	`\cschnx{k}{x}`
$\operatorname{csch}^{\mathrm{k}}(x)$	`\cschn{k}(x)`

On the other hand, I also defined the error functions:

Definitions

```
\newcommand{\erf}               {{\rm erf }}
\newcommand{\erfc}              {{\rm erfc}}
```

and the Airy functions:

Definitions

```
\newcommand{\Ai}                {{\rm Ai}}
\newcommand{\Bi}                {{\rm Bi}}
```

Examples

$\operatorname{erf}(x)$	`\erf(x)`
$\operatorname{erfc}(x)$	`\erfc(x)`

$\operatorname{Ai}(x)$	`\Ai(x)`
$\operatorname{Bi}(x)$	`\Bi(x)`

2.2 Fractions in brackets, absolute values, norms, and square roots of fractions

I use some series of commands involving a fraction very often. Sometimes I type, for example,

$$\left(\frac{f}{g}\right)$$

where the command: `\left(\frac{f}{g}\right)` has been used. When I later want to rewrite these two functions, f and g, to $f(x)$ and $g(x)$. This means that I need to change the parentheses `( )` for the fraction to a pair of bracket `[ ]`:

$$\left[\frac{f(x)}{g(x)}\right]$$

This means also that I must keep to push the ▷ key a while... I'm lazy to do such thing again and again (even just to write some long series of commands once). Hence, I defined the following `\newcommand`s for different bracket involving a fraction:

Definitions

```
\newcommand{\afrac}        [2]  {\left (    \frac{#1}{#2} \right )   }
\newcommand{\bfrac}        [2]  {\left [    \frac{#1}{#2} \right ]   }
\newcommand{\cfrac}        [2]  {\left\{    \frac{#1}{#2} \right\}   }
```

```
\newcommand{\vfrac}        [2]  {\left |    \frac{#1}{#2} \right |   }
\newcommand{\nfrac}        [2]  {\left\Vert \frac{#1}{#2} \right\Vert}
```

```
\newcommand{\sfrac}        [2]  {\sqrt {    \frac{#1}{#2}        }   }
```

Here "a", "b", and "c" correspond to `( )`, `[ ]`, and `{ }`, respectively, "v" stands for the LaTeX command for `|`: "`\vert`", "n" stands for "norm", and "s" for "square root" or the LaTeX command for square root: "`\sqrt`". Now what I need to do is just to type or change the letter before `frac`!

Examples

$\left(\frac{f}{2}\right)$ `\afrac{f}{2}`

$\left[\frac{f(x)}{2}\right]$ `\bfrac{f(x)}{2}`

$\left\{\frac{f(x)[\cdots]}{2}\right\}$ `\cfrac{f(x) [\cdots]}{2}`

$\left|\frac{f(x)}{2}\right|$ `\vfrac{f(x)}{2}`

$\left\|\frac{f(x)}{2}\right\|$ `\nfrac{f(x)}{2}`

$\sqrt{\frac{f(x)}{2}}$ `\sfrac{f(x)}{2}`

On the other hand, sometimes I want to make, for example, the first parentheses in the equation below larger to look more suitable for the later one:

$$\left(\frac{3}{xy}\right)\left(\frac{e^{ax^2+bx+c}}{y^{2/3}}\right)$$

For this aim I have to use the command `\Bigg(\frac{3}{xy}\Bigg)`. Hence, it seems better for me to define some `\newcommand`s for such necessities.

Definitions

```
\newcommand{\Afrac}       [2]  {\Bigg (    \frac{#1}{#2} \Bigg )   }
\newcommand{\Bfrac}       [2]  {\Bigg [    \frac{#1}{#2} \Bigg ]   }
\newcommand{\Cfrac}       [2]  {\Bigg\{    \frac{#1}{#2} \Bigg\}   }
```

```
\newcommand{\Vfrac}       [2]  {\Bigg |    \frac{#1}{#2} \Bigg |   }
\newcommand{\Nfrac}       [2]  {\Bigg\Vert \frac{#1}{#2} \Bigg\Vert}
```

Here I used the capital letters: "A", "B", "C", "V", and "N" to indicate that, first, they are the partner-commands for `\afrac`, `\bfrac`, etc.; second, the common effect of these commands is to make the brackets *larger*. Please note that there is *no* such command like `\Sfrac`.

Examples

$\left(\frac{f}{2}\right)$ `\Afrac{f}{2}`

$\left[\frac{f(x)}{2}\right]$ `\Bfrac{f(x)}{2}`

$\left\{\frac{f(x)[\cdots]}{2}\right\}$ `\Cfrac{f(x) [\cdots]}{2}`

$\left|\frac{f(x)}{2}\right|$ `\Vfrac{f(x)}{2}`

$\left\|\frac{f(x)}{2}\right\|$ `\Nfrac{f(x)}{2}`

Furthermore, sometimes I have to put a minus sign "−" in front of a fraction in bracket, so I defined these `\newcommand`s:

Definitions

```
\newcommand{\amfrac}      [2]  {\left (    -\frac{#1}{#2}\right )   }
\newcommand{\bmfrac}      [2]  {\left [    -\frac{#1}{#2}\right ]   }
\newcommand{\cmfrac}      [2]  {\left\{    -\frac{#1}{#2}\right\}   }
```

```
\newcommand{\vmfrac}      [2]  {\left |    -\frac{#1}{#2}\right |   }
\newcommand{\nmfrac}      [2]  {\left\Vert -\frac{#1}{#2}\right\Vert}
```

```
\newcommand{\smfrac}       [2]  {\sqrt {    -\frac{#1}{#2}       }   }
```

and, similarly, in order to enlarge the brackets, I defined

Definitions

```
\newcommand{\Amfrac}       [2]  {\Bigg ( \hspace{-0.5ex}-\hspace{-0.5ex} \frac{#1}{#2} \Bigg )}
\newcommand{\Bmfrac}       [2]  {\Bigg [ \hspace{-0.5ex}-\hspace{-0.5ex} \frac{#1}{#2} \Bigg ]}
\newcommand{\Cmfrac}       [2]  {\Bigg\{ \hspace{-0.5ex}-\hspace{-0.5ex} \frac{#1}{#2} \Bigg\}}
```

```
\newcommand{\Vmfrac}       [2]  {\Bigg | \hspace{-0.5ex}-\hspace{-0.5ex} \frac{#1}{#2} \Bigg |}
\newcommand{\Nmfrac}       [2]  {\Bigg\Vert \hspace{-0.5ex}-\hspace{-0.5ex} \frac{#1}{#2} \Bigg\Vert}
```

Examples

$\left(-\frac{f}{2}\right)$ `\amfrac{f}{2}`

$\left[-\frac{f(x)}{2}\right]$ `\bmfrac{f(x)}{2}`

$\left\{-\frac{f(x)[\cdots]}{2}\right\}$ `\cmfrac{f(x) [\cdots]}{2}`

$\left|-\frac{f(x)}{2}\right|$ `\vmfrac{f(x)}{2}`

$\left\|-\frac{f(x)}{2}\right\|$ `\nmfrac{f(x)}{2}`

$\sqrt{-\frac{f(x)}{2}}$ `\smfrac{f(x)}{2}`

$\left(-\frac{f}{2}\right)$ `\Amfrac{f}{2}`

$\left[-\frac{f(x)}{2}\right]$ `\Bmfrac{f(x)}{2}`

$\left\{-\frac{f(x)[\cdots]}{2}\right\}$ `\Cmfrac{f(x) [\cdots]}{2}`

$\left|-\frac{f(x)}{2}\right|$ `\Vmfrac{f(x)}{2}`

$\left\|-\frac{f(x)}{2}\right\|$ `\Nmfrac{f(x)}{2}`

2.3 Brackets, absolute values, and norms [†]

After that I had defined some simple `\newcommand`s for fractions in brackets and absolute values and norms of fractions, I found that it is very convenient to use this "a-b-c-v-n" system. Hence, I decided to follow it to define more `\newcommand`s.

Definitions

```
\newcommand{\abrac}        [1]  {\left (    #1 \right )   }

\newcommand{\bbrac}        [1]  {\left [    #1 \right ]   }

\newcommand{\cbrac}        [1]  {\left\{    #1 \right\}   }
```

```
\newcommand{\vbrac}        [1]  {\left |    #1 \right |   }

\newcommand{\nbrac}        [1]  {\left\Vert #1 \right\Vert}
```

Here "a", "b", and "c" correspond to `( )`, `[ ]`, and `{ }`, respectively, "v" stands for the LaTeX command for `|`: "`\vert`", "n" stands for "norm".

Examples

$\left(x^2\right)$ `\abrac{x^2}`

$\left[x^2\right]$ `\bbrac{x^2}`

$\left\{x^2\right\}$ `\cbrac{x^2}`

$\left|x^2\right|$ `\vbrac{x^2}`

$\left\|x^2\right\|$ `\nbrac{x^2}`

On the other hand, sometimes we need a bracket, a absolute value or a norm with just one side, thus I defined the following `\newcommand`s. For cases with the left side,

Definitions

[†] Fresh defined `\newcommand`s

```
\newcommand{\aleft}        [1]  {\left (    #1 \right.}
\newcommand{\bleft}        [1]  {\left [    #1 \right.}
\newcommand{\cleft}        [1]  {\left\{    #1 \right.}
```

```
\newcommand{\vleft}        [1]  {\left |    #1 \right.}
\newcommand{\nleft}        [1]  {\left\Vert #1 \right.}
```

and for cases with the right side,

Definitions

```
\newcommand{\aright}       [1]  {\left. #1 \right )   }
\newcommand{\bright}       [1]  {\left. #1 \right ]   }
\newcommand{\cright}       [1]  {\left. #1 \right\}   }
```

```
\newcommand{\vright}       [1]  {\left. #1 \right |   }
\newcommand{\nright}       [1]  {\left. #1 \right\Vert}
```

Examples

$\left(x^2\right.$	`\aleft{x^2}`
$\left[x^2\right.$	`\bleft{x^2}`
$\left\{x^2\right.$	`\cleft{x^2}`

$\left\vert x^2\right.$	`\vleft{x^2}`
$\left\Vert x^2\right.$	`\nleft{x^2}`

$\left.x^2\right)$	`\aright{x^2}`
$\left.x^2\right]$	`\bright{x^2}`
$\left.x^2\right\}$	`\cright{x^2}`

$\left.x^2\right\vert$	`\vright{x^2}`
$\left.x^2\right\Vert$	`\nright{x^2}`

Furthermore, for enlarging a bracket, a absolute value or a norm, I have

Definitions

```
\newcommand{\aBig}          [1]  {\Big (    #1 \Big )   }
\newcommand{\bBig}          [1]  {\Big [    #1 \Big ]   }
\newcommand{\cBig}          [1]  {\Big\{    #1 \Big\}   }
```

```
\newcommand{\vBig}          [1]  {\Big |    #1 \Big |   }
\newcommand{\nBig}          [1]  {\Big\Vert #1 \Big\Vert}
```

where "Big" stands for the LaTeX command `\Big`. Certainly, I defined `\newcommand`s which correspond to the commands `\big`, `\bigg`, and `\Bigg` at the same time.

Definitions

```
\newcommand{\abig}          [1]  {\big (    #1 \big )   }
\newcommand{\bbig}          [1]  {\big [    #1 \big ]   }
\newcommand{\cbig}          [1]  {\big\{    #1 \big\}   }
\newcommand{\vbig}          [1]  {\big |    #1 \big |   }
\newcommand{\nbig}          [1]  {\big\Vert #1 \big\Vert}
```

```
\newcommand{\abigg}         [1]  {\bigg (    #1 \bigg )   }
\newcommand{\bbigg}         [1]  {\bigg [    #1 \bigg ]   }
\newcommand{\cbigg}         [1]  {\bigg\{    #1 \bigg\}   }
\newcommand{\vbigg}         [1]  {\bigg |    #1 \bigg |   }
\newcommand{\nbigg}         [1]  {\bigg\Vert #1 \bigg\Vert}
```

```
\newcommand{\aBigg}         [1]  {\Bigg (    #1 \Bigg )   }
\newcommand{\bBigg}         [1]  {\Bigg [    #1 \Bigg ]   }
\newcommand{\cBigg}         [1]  {\Bigg\{    #1 \Bigg\}   }
\newcommand{\vBigg}         [1]  {\Bigg |    #1 \Bigg |   }
\newcommand{\nBigg}         [1]  {\Bigg\Vert #1 \Bigg\Vert}
```

Note here that I "didn't" define a `\newcommand` such like `\ambigg` or `\vmBigg` for the enlargement of brackets with parameters having a minus sign.

Examples

(x) `\abig{x}`

$[x]$ `\bbig{x}`

$\{x\}$ `\cbig{x}`

$|-x|$ `\vbig{-x}`

$\|-x\|$ `\nbig{-x}`

$\left(x^2\right)$ `\aBig{x^2}`

$\left[x^2\right]$ `\bBig{x^2}`

$\left\{x^2\right\}$ `\cBig{x^2}`

$\left|-x^2\right|$ `\vBig{-x^2}`

$\left\|-x^2\right\|$ `\nBig{-x^2}`

$\left(x^2\right)$ `\abigg{x^2}`

$\left[x^2\right]$ `\bbigg{x^2}`

$\left\{x^2\right\}$ `\cbigg{x^2}`

$\left|-x^2\right|$ `\vbigg{-x^2}`

$\left\|-x^2\right\|$ `\nbigg{-x^2}`

$\left(x^2\right)$ `\aBigg{x^2}`

$\left[x^2\right]$ `\bBigg{x^2}`

$\left\{x^2\right\}$ `\cBigg{x^2}`

$\left|-x^2\right|$ `\vBigg{-x^2}`

$\left\|-x^2\right\|$ `\nBigg{-x^2}`

Furthermore, for cases in which we need a bracket, a absolute value or a norm with just one side, you just have to add an "l" denoting "left" to the above `\newcommand`s.

Definitions

```
\newcommand{\abigl}        [1]  {\big (    #1 \big.}
\newcommand{\bbigl}        [1]  {\big [    #1 \big.}
\newcommand{\cbigl}        [1]  {\big\{    #1 \big.}
\newcommand{\vbigl}        [1]  {\big |    #1 \big.}
\newcommand{\nbigl}        [1]  {\big\Vert #1 \big.}
```

```
\newcommand{\aBigl}        [1]  {\Big (    #1 \Big.}
\newcommand{\bBigl}        [1]  {\Big [    #1 \Big.}
\newcommand{\cBigl}        [1]  {\Big\{    #1 \Big.}
\newcommand{\vBigl}        [1]  {\Big |    #1 \Big.}
\newcommand{\nBigl}        [1]  {\Big\Vert #1 \Big.}
```

```
\newcommand{\abiggl}       [1]  {\bigg (    #1 \bigg.}
\newcommand{\bbiggl}       [1]  {\bigg [    #1 \bigg.}
\newcommand{\cbiggl}       [1]  {\bigg\{    #1 \bigg.}
\newcommand{\vbiggl}       [1]  {\bigg |    #1 \bigg.}
\newcommand{\nbiggl}       [1]  {\bigg\Vert #1 \bigg.}
```

```
\newcommand{\aBiggl}       [1]  {\Bigg (    #1 \Bigg.}
\newcommand{\bBiggl}       [1]  {\Bigg [    #1 \Bigg.}
\newcommand{\cBiggl}       [1]  {\Bigg\{    #1 \Bigg.}
\newcommand{\vBiggl}       [1]  {\Bigg |    #1 \Bigg.}
\newcommand{\nBiggl}       [1]  {\Bigg\Vert #1 \Bigg.}
```

and, for the right side cases, you can replace the "l" by a "r" denoting "right" to the above `\newcommand`s.

Definitions

```
\newcommand{\abigr}        [1]  {\big. #1 \big )   }
\newcommand{\bbigr}        [1]  {\big. #1 \big ]   }
\newcommand{\cbigr}        [1]  {\big. #1 \big\}   }
\newcommand{\vbigr}        [1]  {\big. #1 \big |   }
\newcommand{\nbigr}        [1]  {\big. #1 \big\Vert}
```

```
\newcommand{\aBigr}        [1]  {\Big. #1 \Big )   }
\newcommand{\bBigr}        [1]  {\Big. #1 \Big ]   }
\newcommand{\cBigr}        [1]  {\Big. #1 \Big\}   }
\newcommand{\vBigr}        [1]  {\Big. #1 \Big |   }
\newcommand{\nBigr}        [1]  {\Big. #1 \Big\Vert}
```

```
\newcommand{\abiggr}       [1]  {\bigg. #1 \bigg )   }
\newcommand{\bbiggr}       [1]  {\bigg. #1 \bigg ]   }
\newcommand{\cbiggr}       [1]  {\bigg. #1 \bigg\}   }
\newcommand{\vbiggr}       [1]  {\bigg. #1 \bigg |   }
\newcommand{\nbiggr}       [1]  {\bigg. #1 \bigg\Vert}
```

```
\newcommand{\aBiggr}       [1]  {\Bigg. #1 \Bigg )   }
\newcommand{\bBiggr}       [1]  {\Bigg. #1 \Bigg ]   }
\newcommand{\cBiggr}       [1]  {\Bigg. #1 \Bigg\}   }
\newcommand{\vBiggr}       [1]  {\Bigg. #1 \Bigg |   }
\newcommand{\nBiggr}       [1]  {\Bigg. #1 \Bigg\Vert}
```

Note here that I "didn't" define a `\newcommand` such like `\ambiggl` or `\vmBiggr` for the enlargement of brackets with parameters having a minus sign.

Examples

$\big(x$	`\abigl{x}`
$\big[x$	`\bbigl{x}`
$\big\{x$	`\cbigl{x}`
$\big\vert -x$	`\vbigl{-x}`
$\big\Vert -x$	`\nbigl{-x}`

$\Big(x^2$ `\aBigl{x^2}`

$\Big[x^2$ `\bBigl{x^2}`

$\Big\{x^2$ `\cBigl{x^2}`

$\Big|-x^2$ `\vBigl{-x^2}`

$\Big\|-x^2$ `\nBigl{-x^2}`

$\bigg(x^2$ `\abiggl{x^2}`

$\bigg[x^2$ `\bbiggl{x^2}`

$\bigg\{x^2$ `\cbiggl{x^2}`

$\bigg|-x^2$ `\vbiggl{-x^2}`

$\bigg\|-x^2$ `\nbiggl{-x^2}`

$\Bigg(x^2$ `\aBiggl{x^2}`

$\Bigg[x^2$ `\bBiggl{x^2}`

$\Bigg\{x^2$ `\cBiggl{x^2}`

$\Bigg|-x^2$ `\vBiggl{-x^2}`

$\Bigg\|-x^2$ `\nBiggl{-x^2}`

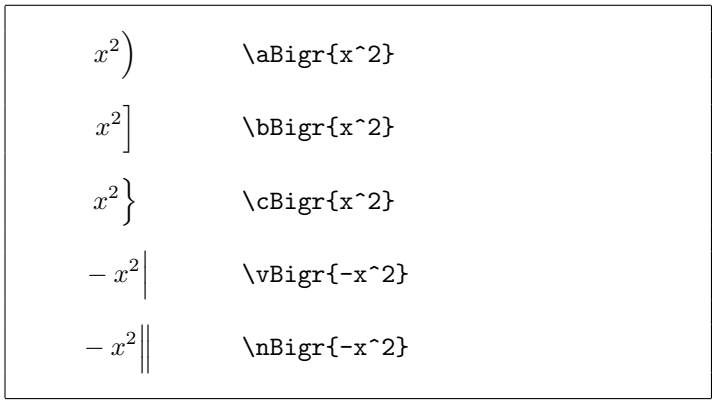
$x\Big)$ `\abigr{x}`

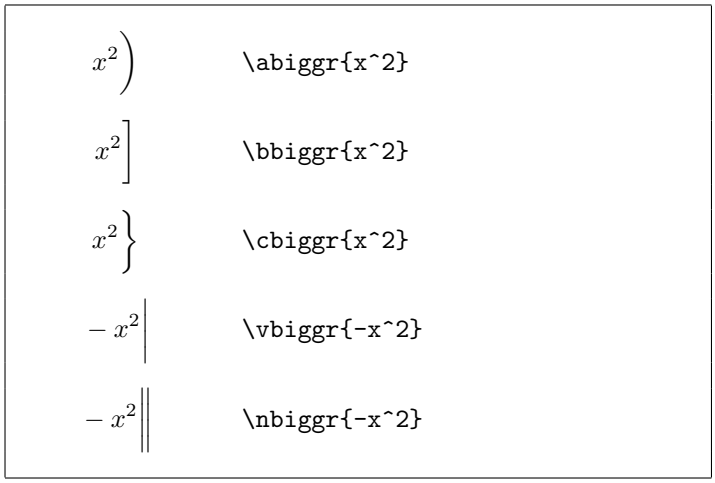
$x\Big]$ `\bbigr{x}`

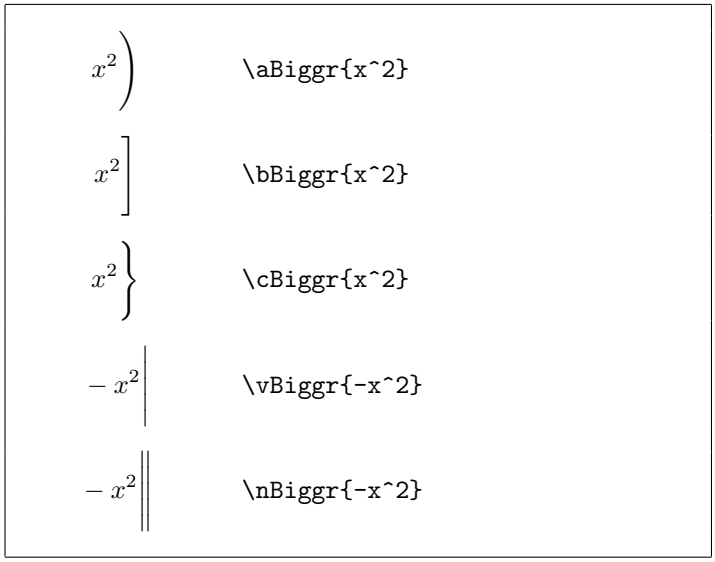
$x\Big\}$ `\cbigr{x}`

$-x\Big|$ `\vbigr{-x}`

$-x\Big\|$ `\nbigr{-x}`







2.4 Accents

First, I had to use the *triple dot* of x in classical mechanics. Hence, I defined this `\newcommand`:

Definition

```
\newcommand{\tdot}              {\stackrel{\cdots}}
```

where the "t" stands for "triple".

Example

$\dddot{a}$	`\tdot{a}`

On the other hand, when we use the original LaTeX commands for accents in the math mode such like: `$\bar{H}$`, `$\tilde{O}$`, and `$\hat{T}$`, we will get $\bar{H}$, $\tilde{O}$, and $\hat{T}$. I personally don't like them. First, they have been always printed in the *italic* type. Second, the accents above the letters are not wide enough. The best solution of these two problems is to define more `\newcommand`s for different types and sizes of accents. For the `\bar` family I have

Definitions

```
\newcommand{\Bar}               {\overline}
```

```
\newcommand{\brm}          [1]  {\bar     {\rm #1}}
\newcommand{\Brm}          [1]  {\overline{\rm #1}}
```

```
\newcommand{\bbf}          [1]  {\bar     {\bf #1}}
\newcommand{\Bbf}          [1]  {\overline{\bf #1}}
```

Here "rm" and "bf" stand for "roman" and "bold face" types (came directly form the LaTeX commands for these two types `\rm` and `\bf`), and I used, as usual, the capital letter "B" for "wide bar". Moreover, the "tilde" and "wide tilde" family have been defined as

Definitions

```
\newcommand{\td}                {\tilde}
\newcommand{\Td}                {\widetilde}
```

```
\newcommand{\trm}          [1]  {\tilde    {\rm #1}}
\newcommand{\Trm}          [1]  {\widetilde{\rm #1}}
```

```
\newcommand{\tbf}          [1]  {\tilde    {\bf #1}}
\newcommand{\Tbf}          [1]  {\widetilde{\bf #1}}
```

where the capital "T" stands for "wide tilde". The `\newcommand`s for "hat" and "wide hat" are

Definitions

```
\newcommand{\h}                 {\widehat}
```

```
\newcommand{\hrm}          [1]  {\hat    {\rm #1}}
\newcommand{\Hrm}          [1]  {\widehat{\rm #1}}
```

```
\newcommand{\hbf}          [1]  {\hat    {\bf #1}}
\newcommand{\Hbf}          [1]  {\widehat{\bf #1}}
```

Note that the `\newcommand` for "wide hat" has been defined as `\h`, with the *small* letter "h", because the command `\H` has already defined as original LaTeX command for ő (`\H{a}`).

Examples

$\overline{U}$	`\Bar{U}`
$\bar{\mathrm{J}}$	`\brm{J}`
$\overline{\mathrm{U}}$	`\Brm{U}`
$\bar{\mathbf{J}}$	`\bbf{J}`
$\overline{\mathbf{U}}$	`\Bbf{U}`

$\tilde{J}$	`\td{J}`
$\widetilde{U}$	`\Td{U}`
$\tilde{\mathrm{J}}$	`\trm{J}`
$\widetilde{\mathrm{U}}$	`\Trm{U}`
$\tilde{\mathbf{J}}$	`\tbf{J}`
$\widetilde{\mathbf{U}}$	`\Tbf{U}`

$\hat{a}$	`\h{a}`
$\hat{\mathrm{I}}$	`\hrm{I}`
$\widehat{\mathrm{U}}$	`\Hrm{U}`
$\hat{\mathbf{I}}$	`\hbf{I}`
$\widehat{\mathbf{U}}$	`\Hbf{U}`

2.5 Greek letters in the bold face print type

Sometimes I have to use the greek letters as vectors or axes in physics. But the (series of) command for a greek letter in bold face type is too long to type and too complicate to remember. So, just define a simple `\newcommand` for always.

Definition

```
\newcommand{\bfG}          [1]  {\mbox{\boldmath${#1}$} }
```

Furthermore, I defined some \newcommands for the cases with accents as following:

Definitions

```
\newcommand{\bbfG}         [1]  {\bar      {\mbox{\boldmath${#1}$}}}
\newcommand{\BbfG}         [1]  {\overline {\mbox{\boldmath${#1}$}}}
```

```
\newcommand{\tbfG}         [1]  {\tilde    {\mbox{\boldmath${#1}$}}}
\newcommand{\TbfG}         [1]  {\widetilde{\mbox{\boldmath${#1}$}}}
```

```
\newcommand{\hbfG}         [1]  {\hat      {\mbox{\boldmath${#1}$}}}
\newcommand{\HbfG}         [1]  {\widehat  {\mbox{\boldmath${#1}$}}}
```

Examples

$\boldsymbol{\omega}$	\bfG{\omega}

$\bar{\boldsymbol{\xi}}$	\bbfG{\xi}
$\overline{\boldsymbol{\Omega}}$	\BbfG{\Omega}

$\tilde{\boldsymbol{\xi}}$	\tbfG{\xi}
$\widetilde{\boldsymbol{\Omega}}$	\TbfG{\Omega}

$\hat{\boldsymbol{\xi}}$	\hbfG{\xi}
$\widehat{\boldsymbol{\Omega}}$	\HbfG{\Omega}

On the other hand, it is convenient for physicists to have some commands for the axes of the coordinate systems specially. For the "Cartisian coordinates", I have

Definitions

```
\newcommand{\Axis}         [1]  {\hspace{0.375ex} \widehat{\bf e}_{#1}}
\newcommand{\axis}         [1]  {\hspace{0.375ex} \widehat{\bf #1}}
```

and for the spherical and cylindrical coordinates,

Definition

```
\newcommand{\axisG}        [1]  {\hspace{0.375ex} \widehat{\mbox{\boldmath${#1}$}}}
```

Examples

$\widehat{\mathbf{e}}_x$	`\Axis{x}`
$\widehat{\mathbf{x}}$	`\axis{x}`

$\widehat{\boldsymbol{\theta}}$	`\axisG{\theta}`

2.6 Differentiations [†]

For a differentiation such like

$$\left(\frac{d^2 f}{dxdy}\right)$$

we need a series of commands: `\left(\frac{d^2 f}{dx dy}\right)`. It is for sure very convenient to define some `\newcommand`s as

Definitions

```
\newcommand{\dd}          [1]  {\frac{d     }{d #1       }}
\newcommand{\ddd}         [1]  {\frac{d^2   }{d #1^2     }}
\newcommand{\dddd}        [2]  {\frac{d^2   }{d #1   d #2}}
\newcommand{\ddn}         [2]  {\frac{d^{#2}}{d #1^{#2}  }}
```

```
\newcommand{\Dd}          [2]  {\frac{d      #1}{d #2       }}
\newcommand{\DDd}         [2]  {\frac{d^2    #1}{d #2^2     }}
\newcommand{\DDdd}        [3]  {\frac{d^2    #1}{d #2   d #3}}
\newcommand{\Ddn}         [3]  {\frac{d^{#3} #1}{d #2^{#3}  }}
```

These commands look complicate. But, they are actually very convenient to remember and use. First, we need to know how many "d"s there are in this expression ($d^2 = dd$ counts as 2). If there is also the differentiated function, e.g., f, here, then we write down a capital "D"; otherwise, we just write down a small "d". Second, we write down what we want to differentiate and with respect to what we differentiate. Note here that, first, for x^2 you just need to give an x as parameter this time; second, if there is no differentiated function, you don't need to (can not!) write { } for the lack differentiate function (This is why the numbers of parameter in the first box above are always one parameter less than those in the second box). Now I give the examples to let you understand better and clearer:

Examples

[†] Fresh defined `\newcommand`s

$\dfrac{d}{dx}$	`\dd{x}`
$\dfrac{d^2}{dx^2}$	`\ddd{x}`
$\dfrac{d^2}{dxdy}$	`\dddd{x}{y}`
$\dfrac{d^k}{dx^k}$	`\ddn{x}{k}`

$\dfrac{df}{dx}$	`\Dd{f}{x}`
$\dfrac{d^2f}{dx^2}$	`\DDd{f}{x}`
$\dfrac{d^2f}{dxdy}$	`\DDdd{f}{x}{y}`
$\dfrac{d^kf}{dx^k}$	`\Ddn{f}{x}{k}`

Moreover, for the expression such like

$$\left(\frac{d}{dx}\right)$$

or

$$\left[\frac{df(x)}{dx}\right]$$

you just have to add an "a" or "b" in front of, for example, `dd` or `DDd`.

Definitions

```
\newcommand{\add}          [1]  {\left(\frac{d     }{d #1       }\right)}
\newcommand{\addd}         [1]  {\left(\frac{d^2   }{d #1^2     }\right)}
\newcommand{\adddd}        [2]  {\left(\frac{d^2   }{d #1   d #2}\right)}
\newcommand{\addn}         [2]  {\left(\frac{d^{#2}}{d #1^{#2}  }\right)}
```

```
\newcommand{\bdd}          [1]  {\left[\frac{d     }{d #1       }\right]}
\newcommand{\bddd}         [1]  {\left[\frac{d^2   }{d #1^2     }\right]}
\newcommand{\bdddd}        [2]  {\left[\frac{d^2   }{d #1   d #2}\right]}
\newcommand{\bddn}         [2]  {\left[\frac{d^{#2}}{d #1^{#2}  }\right]}
```

```
\newcommand{\aDd}          [2]  {\left(\frac{d      #1}{d #2       }\right)}
\newcommand{\aDDd}         [2]  {\left(\frac{d^2    #1}{d #2^2     }\right)}
\newcommand{\aDDdd}        [3]  {\left(\frac{d^2    #1}{d #2   d #3}\right)}
\newcommand{\aDdn}         [3]  {\left(\frac{d^{#3} #1}{d #2^{#3}  }\right)}
```

```
\newcommand{\bDd}          [2]  {\left[\frac{d      #1}{d #2       }\right]}
\newcommand{\bDDd}         [2]  {\left[\frac{d^2    #1}{d #2^2     }\right]}
\newcommand{\bDDdd}        [3]  {\left[\frac{d^2    #1}{d #2   d #3}\right]}
\newcommand{\bDdn}         [3]  {\left[\frac{d^{#3} #1}{d #2^{#3}  }\right]}
```

Examples

$$\left(\frac{d}{dx}\right)$$ `\add{x}`

$$\left(\frac{d^2}{dx^2}\right)$$ `\addd{x}`

$$\left(\frac{d^2}{dxdy}\right)$$ `\adddd{x}{y}`

$$\left(\frac{d^k}{dx^k}\right)$$ `\addn{x}{k}`

$$\left[\frac{d}{dx}\right]$$ `\bdd{x}`

$$\left[\frac{d^2}{dx^2}\right]$$ `\bddd{x}`

$$\left[\frac{d^2}{dxdy}\right]$$ `\bdddd{x}{y}`

$$\left[\frac{d^k}{dx^k}\right]$$ `\bddn{x}{k}`

$$\left(\frac{df}{dx}\right)$$ `\aDd{f}{x}`

$$\left(\frac{d^2f}{dx^2}\right)$$ `\aDDd{f}{x}`

$$\left(\frac{d^2f}{dxdy}\right)$$ `\aDDdd{f}{x}{y}`

$$\left(\frac{d^kf}{dx^k}\right)$$ `\aDdn{f}{x}{k}`

$\left[\frac{df(x)}{dx}\right]$ `\bDd{f(x)}{x}`

$\left[\frac{d^2f(x)}{dx^2}\right]$ `\bDDd{f(x)}{x}`

$\left[\frac{d^2f(x,y)}{dxdy}\right]$ `\bDDdd{f(x,y)}{x}{y}`

$\left[\frac{d^kf(x,y)}{dx^k}\right]$ `\bDdn{f(x,y)}{x}{k}`

Moreover, in order to complete my "a-b-c-v-n-s" system for differentiations, I added the following `\newcommand`s, for the expressions which have d/dx form,

Definitions

```
\newcommand{\cdd}          [1]  {\left\{   \frac{d     }{d #1       }\right\}   }
\newcommand{\cddd}         [1]  {\left\{   \frac{d^2   }{d #1^2     }\right\}   }
\newcommand{\cddddd}       [2]  {\left\{   \frac{d^2   }{d #1   d #2}\right\}   }
\newcommand{\cddn}         [2]  {\left\{   \frac{d^{#2}}{d #1^{#2}  }\right\}   }
```

```
\newcommand{\vdd}          [1]  {\left |   \frac{d     }{d #1       }\right |   }
\newcommand{\vddd}         [1]  {\left |   \frac{d^2   }{d #1^2     }\right |   }
\newcommand{\vddddd}       [2]  {\left |   \frac{d^2   }{d #1   d #2}\right |   }
\newcommand{\vddn}         [2]  {\left |   \frac{d^{#2}}{d #1^{#2}  }\right |   }
```

```
\newcommand{\ndd}          [1]  {\left\Vert\frac{d     }{d #1       }\right\Vert}
\newcommand{\nddd}         [1]  {\left\Vert\frac{d^2   }{d #1^2     }\right\Vert}
\newcommand{\nddddd}       [2]  {\left\Vert\frac{d^2   }{d #1   d #2}\right\Vert}
\newcommand{\nddn}         [2]  {\left\Vert\frac{d^{#2}}{d #1^{#2}  }\right\Vert}
```

```
\newcommand{\sdd}          [1]  {\sqrt {   \frac{d     }{d #1       }\right }   }
\newcommand{\sddd}         [1]  {\sqrt {   \frac{d^2   }{d #1^2     }\right }   }
\newcommand{\sddddd}       [2]  {\sqrt {   \frac{d^2   }{d #1   d #2}\right }   }
\newcommand{\sddn}         [2]  {\sqrt {   \frac{d^{#2}}{d #1^{#2}  }\right }   }
```

Examples

$\left\{\frac{d}{dx}\right\}$ `\cdd{x}`

$\left\{\frac{d^2}{dx^2}\right\}$ `\cddd{x}`

$\left\{\frac{d^2}{dxdy}\right\}$ `\cdddd{x}{y}`

$\left\{\frac{d^k}{dx^k}\right\}$ `\cddn{x}{k}`

$\left|\frac{d}{dx}\right|$ `\vdd{x}`

$\left|\frac{d^2}{dx^2}\right|$ `\vddd{x}`

$\left|\frac{d^2}{dxdy}\right|$ `\vdddd{x}{y}`

$\left|\frac{d^k}{dx^k}\right|$ `\vddn{x}{k}`

$\left\|\frac{d}{dx}\right\|$ `\ndd{x}`

$\left\|\frac{d^2}{dx^2}\right\|$ `\nddd{x}`

$\left\|\frac{d^2}{dxdy}\right\|$ `\ndddd{x}{y}`

$\left\|\frac{d^k}{dx^k}\right\|$ `\nddn{x}{k}`

$\sqrt{\frac{d}{dx}}$ `\sdd{x}`

$\sqrt{\frac{d^2}{dx^2}}$ `\sddd{x}`

$\sqrt{\frac{d^2}{dxdy}}$ `\sdddd{x}{y}`

$\sqrt{\frac{d^k}{dx^k}}$ `\sddn{x}{k}`

For the differentiations which have df/dx form, I have

Definitions

```
\newcommand{\cDd}          [2]  {\left\{   \frac{d      #1}{d #2       }\right\}   }
\newcommand{\cDDd}         [2]  {\left\{   \frac{d^2    #1}{d #2^2     }\right\}   }
\newcommand{\cDDdd}        [3]  {\left\{   \frac{d^2    #1}{d #2   d #3}\right\}   }
\newcommand{\cDdn}         [3]  {\left\{   \frac{d^{#3} #1}{d #2^{#3}  }\right\}   }
```

```
\newcommand{\vDd}          [2]  {\left |   \frac{d      #1}{d #2       }\right |   }
\newcommand{\vDDd}         [2]  {\left |   \frac{d^2    #1}{d #2^2     }\right |   }
\newcommand{\vDDdd}        [3]  {\left |   \frac{d^2    #1}{d #2   d #3}\right |   }
\newcommand{\vDdn}         [3]  {\left |   \frac{d^{#3} #1}{d #2^{#3}  }\right |   }
```

```
\newcommand{\nDd}          [2]  {\left\Vert\frac{d      #1}{d #2       }\right\Vert}
\newcommand{\nDDd}         [2]  {\left\Vert\frac{d^2    #1}{d #2^2     }\right\Vert}
\newcommand{\nDDdd}        [3]  {\left\Vert\frac{d^2    #1}{d #2   d #3}\right\Vert}
\newcommand{\nDdn}         [3]  {\left\Vert\frac{d^{#3} #1}{d #2^{#3}  }\right\Vert}
```

```
\newcommand{\sDd}          [2]  {\sqrt {   \frac{d      #1}{d #2       }       }   }
\newcommand{\sDDd}         [2]  {\sqrt {   \frac{d^2    #1}{d #2^2     }       }   }
\newcommand{\sDDdd}        [3]  {\sqrt {   \frac{d^2    #1}{d #2   d #3}       }   }
\newcommand{\sDdn}         [3]  {\sqrt {   \frac{d^{#3} #1}{d #2^{#3}  }       }   }
```

Examples

$\left\{\frac{df(x)}{dx}\right\}$ `\cDd{f(x)}{x}`

$\left\{\frac{d^2f(x)}{dx^2}\right\}$ `\cDDd{f(x)}{x}`

$\left\{\frac{d^2f(x,y)}{dxdy}\right\}$ `\cDDdd{f(x,y)}{x}{y}`

$\left\{\frac{d^kf(x,y)}{dx^k}\right\}$ `\cDdn{f(x,y)}{x}{k}`

$\left\lvert \frac{df}{dx} \right\rvert$	`\vDd{f}{x}`
$\left\lvert \frac{d^2 f}{dx^2} \right\rvert$	`\vDDd{f}{x}`
$\left\lvert \frac{d^2 f}{dxdy} \right\rvert$	`\vDDdd{f}{x}{y}`
$\left\lvert \frac{d^k f}{dx^k} \right\rvert$	`\vDdn{f}{x}{k}`

$\left\lVert \frac{df}{dx} \right\rVert$	`\nDd{f}{x}`
$\left\lVert \frac{d^2 f}{dx^2} \right\rVert$	`\nDDd{f}{x}`
$\left\lVert \frac{d^2 f}{dxdy} \right\rVert$	`\nDDdd{f}{x}{y}`
$\left\lVert \frac{d^k f}{dx^k} \right\rVert$	`\nDdn{f}{x}{k}`

$\sqrt{\frac{df}{dx}}$	`\sDd{f}{x}`
$\sqrt{\frac{d^2 f}{dx^2}}$	`\sDDd{f}{x}`
$\sqrt{\frac{d^2 f}{dxdy}}$	`\sDDdd{f}{x}{y}`
$\sqrt{\frac{d^k f}{dx^k}}$	`\sDdn{f}{x}{k}`

Similar to the definitions like `\Afrac`, you can use the following `\newcommand`s to enlarge the above brackets or square root. Corresponding to `\add`, `\vdddd` and so on, I have

Definitions

```
\newcommand{\Add}          [1]  {\Bigg (   \frac{d     }{d #1       }\Bigg )   }
\newcommand{\Addd}         [1]  {\Bigg (   \frac{d^2   }{d #1^2     }\Bigg )   }
\newcommand{\Adddd}        [2]  {\Bigg (   \frac{d^2   }{d #1   d #2}\Bigg )   }
\newcommand{\Addn}         [2]  {\Bigg (   \frac{d^{#2}}{d #1^{#2}  }\Bigg )   }
```

```
\newcommand{\Bdd}          [1]  {\Bigg [   \frac{d     }{d #1       }\Bigg ]   }
\newcommand{\Bddd}         [1]  {\Bigg [   \frac{d^2   }{d #1^2     }\Bigg ]   }
\newcommand{\Bdddd}        [2]  {\Bigg [   \frac{d^2   }{d #1   d #2}\Bigg ]   }
\newcommand{\Bddn}         [2]  {\Bigg [   \frac{d^{#2}}{d #1^{#2}  }\Bigg ]   }
```

```
\newcommand{\Cdd}          [1]  {\Bigg\{   \frac{d     }{d #1       }\Bigg\}   }
\newcommand{\Cddd}         [1]  {\Bigg\{   \frac{d^2   }{d #1^2     }\Bigg\}   }
\newcommand{\Cdddd}        [2]  {\Bigg\{   \frac{d^2   }{d #1   d #2}\Bigg\}   }
\newcommand{\Cddn}         [2]  {\Bigg\{   \frac{d^{#2}}{d #1^{#2}  }\Bigg\}   }
```

```
\newcommand{\Vdd}          [1]  {\Bigg |   \frac{d     }{d #1       }\Bigg |   }
\newcommand{\Vddd}         [1]  {\Bigg |   \frac{d^2   }{d #1^2     }\Bigg |   }
\newcommand{\Vdddd}        [2]  {\Bigg |   \frac{d^2   }{d #1   d #2}\Bigg |   }
\newcommand{\Vddn}         [2]  {\Bigg |   \frac{d^{#2}}{d #1^{#2}  }\Bigg |   }
```

```
\newcommand{\Ndd}          [1]  {\Bigg\Vert\frac{d     }{d #1       }\Bigg\Vert}
\newcommand{\Nddd}         [1]  {\Bigg\Vert\frac{d^2   }{d #1^2     }\Bigg\Vert}
\newcommand{\Ndddd}        [2]  {\Bigg\Vert\frac{d^2   }{d #1   d #2}\Bigg\Vert}
\newcommand{\Nddn}         [2]  {\Bigg\Vert\frac{d^{#2}}{d #1^{#2}  }\Bigg\Vert}
```

Examples

$\left(\frac{d}{dx}\right)$ `\Add{x}`

$\left(\frac{d^2}{dx^2}\right)$ `\Addd{x}`

$\left(\frac{d^2}{dxdy}\right)$ `\Adddd{x}{y}`

$\left(\frac{d^k}{dx^k}\right)$ `\Addn{x}{k}`

$\left[\frac{d}{dx}\right]$ `\Bdd{x}`

$\left[\frac{d^2}{dx^2}\right]$ `\Bddd{x}`

$\left[\frac{d^2}{dxdy}\right]$ `\Bdddd{x}{y}`

$\left[\frac{d^k}{dx^k}\right]$ `\Bddn{x}{k}`

$\left\{\frac{d}{dx}\right\}$ `\Cdd{x}`

$\left\{\frac{d^2}{dx^2}\right\}$ `\Cddd{x}`

$\left\{\frac{d^2}{dxdy}\right\}$ `\Cdddd{x}{y}`

$\left\{\frac{d^k}{dx^k}\right\}$ `\Cddn{x}{k}`

$\left|\frac{d}{dx}\right|$ `\Vdd{x}`

$\left|\frac{d^2}{dx^2}\right|$ `\Vddd{x}`

$\left|\frac{d^2}{dxdy}\right|$ `\Vdddd{x}{y}`

$\left|\frac{d^k}{dx^k}\right|$ `\Vddn{x}{k}`

$\left\|\frac{d}{dx}\right\|$ `\Ndd{x}`

$\left\|\frac{d^2}{dx^2}\right\|$ `\Nddd{x}`

$\left\|\frac{d^2}{dxdy}\right\|$ `\Ndddd{x}{y}`

$\left\|\frac{d^k}{dx^k}\right\|$ `\Nddn{x}{k}`

Corresponding to `\aDd`, `\vDDdd` and so on, I have

Definitions

```
\newcommand{\ADd}          [2]  {\Bigg (   \frac{d      #1}{d #2       }\Bigg )   }
\newcommand{\ADDd}         [2]  {\Bigg (   \frac{d^2    #1}{d #2^2     }\Bigg )   }
\newcommand{\ADDdd}        [3]  {\Bigg (   \frac{d^2    #1}{d #2   d #3}\Bigg )   }
\newcommand{\ADdn}         [3]  {\Bigg (   \frac{d^{#3} #1}{d #2^{#3}  }\Bigg )   }
```

```
\newcommand{\BDd}          [2]  {\Bigg [   \frac{d      #1}{d #2       }\Bigg ]   }
\newcommand{\BDDd}         [2]  {\Bigg [   \frac{d^2    #1}{d #2^2     }\Bigg ]   }
\newcommand{\BDDdd}        [3]  {\Bigg [   \frac{d^2    #1}{d #2   d #3}\Bigg ]   }
\newcommand{\BDdn}         [3]  {\Bigg [   \frac{d^{#3} #1}{d #2^{#3}  }\Bigg ]   }
```

```
\newcommand{\CDd}          [2]  {\Bigg\{   \frac{d      #1}{d #2       }\Bigg\}   }
\newcommand{\CDDd}         [2]  {\Bigg\{   \frac{d^2    #1}{d #2^2     }\Bigg\}   }
\newcommand{\CDDdd}        [3]  {\Bigg\{   \frac{d^2    #1}{d #2   d #3}\Bigg\}   }
\newcommand{\CDdn}         [3]  {\Bigg\{   \frac{d^{#3} #1}{d #2^{#3}  }\Bigg\}   }
```

```
\newcommand{\VDd}          [2]  {\Bigg |   \frac{d      #1}{d #2       }\Bigg |   }
\newcommand{\VDDd}         [2]  {\Bigg |   \frac{d^2    #1}{d #2^2     }\Bigg |   }
\newcommand{\VDDdd}        [3]  {\Bigg |   \frac{d^2    #1}{d #2   d #3}\Bigg |   }
\newcommand{\VDdn}         [3]  {\Bigg |   \frac{d^{#3} #1}{d #2^{#3}  }\Bigg |   }
```

```
\newcommand{\NDd}          [2]  {\Bigg\Vert\frac{d      #1}{d #2       }\Bigg\Vert}
\newcommand{\NDDd}         [2]  {\Bigg\Vert\frac{d^2    #1}{d #2^2     }\Bigg\Vert}
\newcommand{\NDDdd}        [3]  {\Bigg\Vert\frac{d^2    #1}{d #2   d #3}\Bigg\Vert}
\newcommand{\NDdn}         [3]  {\Bigg\Vert\frac{d^{#3} #1}{d #2^{#3}  }\Bigg\Vert}
```

Examples

$$\left(\frac{df}{dx}\right)$$ `\ADd{f}{x}`

$$\left(\frac{d^2f}{dx^2}\right)$$ `\ADDd{f}{x}`

$$\left(\frac{d^2f}{dxdy}\right)$$ `\ADDdd{f}{x}{y}`

$$\left(\frac{d^kf}{dx^k}\right)$$ `\ADdn{f}{x}{k}`

$$\left[\frac{df(x)}{dx}\right]$$ `\BDd{f(x)}{x}`

$$\left[\frac{d^2f(x)}{dx^2}\right]$$ `\BDDd{f(x)}{x}`

$$\left[\frac{d^2f(x,y)}{dxdy}\right]$$ `\BDDdd{f(x,y)}{x}{y}`

$$\left[\frac{d^kf(x,y)}{dx^k}\right]$$ `\BDdn{f(x,y)}{x}{k}`

$$\left\{\frac{df(x)}{dx}\right\}$$ `\CDd{f(x)}{x}`

$$\left\{\frac{d^2f(x)}{dx^2}\right\}$$ `\CDDd{f(x)}{x}`

$$\left\{\frac{d^2f(x,y)}{dxdy}\right\}$$ `\CDDdd{f(x,y)}{x}{y}`

$$\left\{\frac{d^kf(x,y)}{dx^k}\right\}$$ `\CDdn{f(x,y)}{x}{k}`

$$\left|\frac{df}{dx}\right|$$ `\VDd{f}{x}`

$$\left|\frac{d^2f}{dx^2}\right|$$ `\VDDd{f}{x}`

$$\left|\frac{d^2f}{dxdy}\right|$$ `\VDDdd{f}{x}{y}`

$$\left|\frac{d^kf}{dx^k}\right|$$ `\VDdn{f}{x}{k}`

$\left\\|\frac{df}{dx}\right\\|$	`\NDd{f}{x}`
$\left\\|\frac{d^2f}{dx^2}\right\\|$	`\NDDd{f}{x}`
$\left\\|\frac{d^2f}{dxdy}\right\\|$	`\NDDdd{f}{x}{y}`
$\left\\|\frac{d^kf}{dx^k}\right\\|$	`\NDdn{f}{x}{k}`

Note that there is no such `\newcommand` like `\Sdd` or `\SDDdd`.

2.7 Partial differentiations †

First, I defined an abbreviation for the original LaTeX command `\partial` as

Definition

```
\newcommand{\p}                {\partial}
```

Then, as for the ordinary differentiation, I defined the following `\newcommand`s:

Definitions

```
\newcommand{\pp}          [1]  {\frac{\partial     }{\partial #1              }}
\newcommand{\ppp}         [1]  {\frac{\partial^2   }{\partial #1^2            }}
\newcommand{\pppp}        [2]  {\frac{\partial^2   }{\partial #1   \partial #2}}
\newcommand{\ppn}         [2]  {\frac{\partial^{#2}}{\partial #1^{#2}         }}
```

```
\newcommand{\Pp}          [2]  {\frac{\partial      #1}{\partial #2              }}
\newcommand{\PPp}         [2]  {\frac{\partial^2    #1}{\partial #2^2            }}
\newcommand{\PPpp}        [3]  {\frac{\partial^2    #1}{\partial #2   \partial #3}}
\newcommand{\Ppn}         [3]  {\frac{\partial^{#3} #1}{\partial #2^{#3}         }}
```

Here you just have to replace "d" or "D" in the `\newcommand`s for normal differentiations by "p" or "P" to get the `\newcommand`s for partial differentiations.

Examples

†Fresh defined `\newcommand`s

$\dfrac{\partial}{\partial x}$	`\pp{x}`
$\dfrac{\partial^2}{\partial x^2}$	`\ppp{x}`
$\dfrac{\partial^2}{\partial x \partial y}$	`\pppp{x}{y}`
$\dfrac{\partial^k}{\partial x^k}$	`\ppn{x}{k}`

$\dfrac{\partial f}{\partial x}$	`\Pp{f}{x}`
$\dfrac{\partial^2 f}{\partial x^2}$	`\PPp{f}{x}`
$\dfrac{\partial^2 f}{\partial x \partial y}$	`\PPpp{f}{x}{y}`
$\dfrac{\partial^k f}{\partial x^k}$	`\Ppn{f}{x}{k}`

Also, for the partial differentiations having a $\partial/\partial x$-like form in parentheses, in bracket, in a square root, I have

Definitions

```
\newcommand{\app}          [1]  {\left (\frac{\partial    }{\partial #1             }\right )}
\newcommand{\appp}         [1]  {\left (\frac{\partial^2  }{\partial #1^2           }\right )}
\newcommand{\appppp}       [2]  {\left (\frac{\partial^2  }{\partial #1  \partial #2}\right )}
\newcommand{\appn}         [2]  {\left (\frac{\partial^{#2}}{\partial #1^{#2}        }\right )}
```

```
\newcommand{\bpp}          [1]  {\left [\frac{\partial    }{\partial #1             }\right ]}
\newcommand{\bppp}         [1]  {\left [\frac{\partial^2  }{\partial #1^2           }\right ]}
\newcommand{\bpppp}        [2]  {\left [\frac{\partial^2  }{\partial #1  \partial #2}\right ]}
\newcommand{\bppn}         [2]  {\left [\frac{\partial^{#2}}{\partial #1^{#2}        }\right ]}
```

```
\newcommand{\cpp}          [1]  {\left\{\frac{\partial    }{\partial #1             }\right\}}
\newcommand{\cppp}         [1]  {\left\{\frac{\partial^2  }{\partial #1^2           }\right\}}
\newcommand{\cpppp}        [2]  {\left\{\frac{\partial^2  }{\partial #1  \partial #2}\right\}}
\newcommand{\cppn}         [2]  {\left\{\frac{\partial^{#2}}{\partial #1^{#2}        }\right\}}
```

```
\newcommand{\vpp}          [1]  {\left |\frac{\partial     }{\partial #1              }\right |}
\newcommand{\vppp}         [1]  {\left |\frac{\partial^2   }{\partial #1^2            }\right |}
\newcommand{\vpppp}        [2]  {\left |\frac{\partial^2   }{\partial #1   \partial #2}\right |}
\newcommand{\vppn}         [2]  {\left |\frac{\partial^{#2}}{\partial #1^{#2}         }\right |}
```

```
\newcommand{\npp}          [1]  {\left\Vert\frac{\partial     }{\partial #1              }\right\Vert}
\newcommand{\nppp}         [1]  {\left\Vert\frac{\partial^2   }{\partial #1^2            }\right\Vert}
\newcommand{\npppp}        [2]  {\left\Vert\frac{\partial^2   }{\partial #1   \partial #2}\right\Vert}
\newcommand{\nppn}         [2]  {\left\Vert\frac{\partial^{#2}}{\partial #1^{#2}         }\right\Vert}
```

```
\newcommand{\spp}          [1]  {\sqrt {\frac{\partial     }{\partial #1              }       }}
\newcommand{\sppp}         [1]  {\sqrt {\frac{\partial^2   }{\partial #1^2            }       }}
\newcommand{\spppp}        [2]  {\sqrt {\frac{\partial^2   }{\partial #1   \partial #2}       }}
\newcommand{\sppn}         [2]  {\sqrt {\frac{\partial^{#2}}{\partial #1^{#2}         }       }}
```

Examples

$\left(\frac{\partial}{\partial x}\right)$ `\app{x}`

$\left(\frac{\partial^2}{\partial x^2}\right)$ `\appp{x}`

$\left(\frac{\partial^2}{\partial x \partial y}\right)$ `\apppp{x}{y}`

$\left(\frac{\partial^k}{\partial x^k}\right)$ `\appn{x}{k}`

$\left[\frac{\partial}{\partial x}\right]$ `\bpp{x}`

$\left[\frac{\partial^2}{\partial x^2}\right]$ `\bppp{x}`

$\left[\frac{\partial^2}{\partial x \partial y}\right]$ `\bpppp{x}{y}`

$\left[\frac{\partial^k}{\partial x^k}\right]$ `\bppn{x}{k}`

$\left\{ \frac{\partial}{\partial x} \right\}$ `\cpp{x}`

$\left\{ \frac{\partial^2}{\partial x^2} \right\}$ `\cppp{x}`

$\left\{ \frac{\partial^2}{\partial x \partial y} \right\}$ `\cpppp{x}{y}`

$\left\{ \frac{\partial^k}{\partial x^k} \right\}$ `\cppn{x}{k}`

$\left| \frac{\partial}{\partial x} \right|$ `\vpp{x}`

$\left| \frac{\partial^2}{\partial x^2} \right|$ `\vppp{x}`

$\left| \frac{\partial^2}{\partial x \partial y} \right|$ `\vpppp{x}{y}`

$\left| \frac{\partial^k}{\partial x^k} \right|$ `\vppn{x}{k}`

$\left\| \frac{\partial}{\partial x} \right\|$ `\npp{x}`

$\left\| \frac{\partial^2}{\partial x^2} \right\|$ `\nppp{x}`

$\left\| \frac{\partial^2}{\partial x \partial y} \right\|$ `\npppp{x}{y}`

$\left\| \frac{\partial^k}{\partial x^k} \right\|$ `\nppn{x}{k}`

$\sqrt{\frac{\partial}{\partial x}}$ `\spp{x}`

$\sqrt{\frac{\partial^2}{\partial x^2}}$ `\sppp{x}`

$\sqrt{\frac{\partial^2}{\partial x \partial y}}$ `\spppp{x}{y}`

$\sqrt{\frac{\partial^k}{\partial x^k}}$ `\sppn{x}{k}`

For the partial differentiations having a $\partial f/\partial x$-like form in parentheses, in bracket, in a square root, I have

Definitions

```
\newcommand{\aPp}          [2]  {\left (   \frac{\partial      #1}{\partial #2             }\right )   }
\newcommand{\aPPp}         [2]  {\left (   \frac{\partial^2    #1}{\partial #2^2           }\right )   }
\newcommand{\aPPpp}        [3]  {\left (   \frac{\partial^2    #1}{\partial #2   \partial #3}\right )   }
\newcommand{\aPpn}         [3]  {\left (   \frac{\partial^{#3} #1}{\partial #2^{#3}        }\right )   }
```

```
\newcommand{\bPp}          [2]  {\left [   \frac{\partial      #1}{\partial #2             }\right ]   }
\newcommand{\bPPp}         [2]  {\left [   \frac{\partial^2    #1}{\partial #2 ^2          }\right ]   }
\newcommand{\bPPpp}        [3]  {\left [   \frac{\partial^2    #1}{\partial #2   \partial #3}\right ]   }
\newcommand{\bPpn}         [3]  {\left [   \frac{\partial^{#3} #1}{\partial #2^{#3}        }\right ]   }
```

```
\newcommand{\cPp}          [2]  {\left\{   \frac{\partial      #1}{\partial #2             }\right\}   }
\newcommand{\cPPp}         [2]  {\left\{   \frac{\partial^2    #1}{\partial #2 ^2          }\right\}   }
\newcommand{\cPPpp}        [3]  {\left\{   \frac{\partial^2    #1}{\partial #2   \partial #3}\right\}   }
\newcommand{\cPpn}         [3]  {\left\{   \frac{\partial^{#3} #1}{\partial #2^{#3}        }\right\}   }
```

```
\newcommand{\vPp}          [2]  {\left |   \frac{\partial      #1}{\partial #2             }\right |   }
\newcommand{\vPPp}         [2]  {\left |   \frac{\partial^2    #1}{\partial #2 ^2          }\right |   }
\newcommand{\vPPpp}        [3]  {\left |   \frac{\partial^2    #1}{\partial #2   \partial #3}\right |   }
\newcommand{\vPpn}         [3]  {\left |   \frac{\partial^{#3} #1}{\partial #2^{#3}        }\right |   }
```

```
\newcommand{\nPp}          [2]  {\left\Vert\frac{\partial      #1}{\partial #2             }\right\Vert}
\newcommand{\nPPp}         [2]  {\left\Vert\frac{\partial^2    #1}{\partial #2 ^2          }\right\Vert}
\newcommand{\nPPpp}        [3]  {\left\Vert\frac{\partial^2    #1}{\partial #2   \partial #3}\right\Vert}
\newcommand{\nPpn}         [3]  {\left\Vert\frac{\partial^{#3} #1}{\partial #2^{#3}        }\right\Vert}
```

```
\newcommand{\sPp}          [2]  {\sqrt {   \frac{\partial      #1}{\partial #2             }       }   }
\newcommand{\sPPp}         [2]  {\sqrt {   \frac{\partial^2    #1}{\partial #2 ^2          }       }   }
\newcommand{\sPPpp}        [3]  {\sqrt {   \frac{\partial^2    #1}{\partial #2   \partial #3}       }   }
\newcommand{\sPpn}         [3]  {\sqrt {   \frac{\partial^{#3} #1}{\partial #2^{#3}        }       }   }
```

Examples

$\left(\frac{\partial f}{\partial x}\right)$ `\aPp{f}{x}`

$\left(\frac{\partial^2 f}{\partial x^2}\right)$ `\aPPp{f}{x}`

$\left(\frac{\partial^2 f}{\partial x \partial y}\right)$ `\aPPpp{f}{x}{y}`

$\left(\frac{\partial^k f}{\partial x^k}\right)$ `\aPpn{f}{x}{k}`

$\left[\frac{\partial f(x,y)}{\partial x}\right]$ `\bPp{f(x,y)}{x}`

$\left[\frac{\partial^2 f(x,y)}{\partial x^2}\right]$ `\bPPp{f(x,y)}{x}`

$\left[\frac{\partial^2 f(x,y)}{\partial x \partial y}\right]$ `\bPPpp{f(x,y)}{x}{y}`

$\left[\frac{\partial^k f(x,y)}{\partial x^k}\right]$ `\bPpn{f(x,y)}{x}{k}`

$\left\{\frac{\partial f(x,y)}{\partial x}\right\}$ `\cPp{f(x,y)}{x}`

$\left\{\frac{\partial^2 f(x,y)}{\partial x^2}\right\}$ `\cPPp{f(x,y)}{x}`

$\left\{\frac{\partial^2 f(x,y)}{\partial x \partial y}\right\}$ `\cPPpp{f(x,y)}{x}{y}`

$\left\{\frac{\partial^k f(x,y)}{\partial x^k}\right\}$ `\cPpn{f(x,y)}{x}{k}`

$\left|\frac{\partial f}{\partial x}\right|$ `\vPp{f}{x}`

$\left|\frac{\partial^2 f}{\partial x^2}\right|$ `\vPPp{f}{x}`

$\left|\frac{\partial^2 f}{\partial x \partial y}\right|$ `\vPPpp{f}{x}{y}`

$\left|\frac{\partial^k f}{\partial x^k}\right|$ `\vPpn{f}{x}{k}`

$\left\|\frac{\partial f}{\partial x}\right\|$	`\nPp{f}{x}`
$\left\|\frac{\partial^2 f}{\partial x^2}\right\|$	`\nPPp{f}{x}`
$\left\|\frac{\partial^2 f}{\partial x \partial y}\right\|$	`\nPPpp{f}{x}{y}`
$\left\|\frac{\partial^k f}{\partial x^k}\right\|$	`\nPpn{f}{x}{k}`

$\sqrt{\frac{\partial f}{\partial x}}$	`\sPp{f}{x}`
$\sqrt{\frac{\partial^2 f}{\partial x^2}}$	`\sPPp{f}{x}`
$\sqrt{\frac{\partial^2 f}{\partial x \partial y}}$	`\sPPpp{f}{x}{y}`
$\sqrt{\frac{\partial^k f}{\partial x^k}}$	`\sPpn{f}{x}{k}`

For sure, I defined the following `\newcommand`s to enlarge the $(\partial/\partial x)$-like partial differentiations:

Definitions

```
\newcommand{\App}          [1]  {\Bigg (\frac{\partial    }{\partial #1             }\Bigg )}
\newcommand{\Appp}         [1]  {\Bigg (\frac{\partial^2  }{\partial #1^2           }\Bigg )}
\newcommand{\Apppp}        [2]  {\Bigg (\frac{\partial^2  }{\partial #1  \partial #2}\Bigg )}
\newcommand{\Appn}         [2]  {\Bigg (\frac{\partial^{#2}}{\partial #1^{#2}       }\Bigg )}
```

```
\newcommand{\Bpp}          [1]  {\Bigg [\frac{\partial    }{\partial #1             }\Bigg ]}
\newcommand{\Bppp}         [1]  {\Bigg [\frac{\partial^2  }{\partial #1^2           }\Bigg ]}
\newcommand{\Bpppp}        [2]  {\Bigg [\frac{\partial^2  }{\partial #1  \partial #2}\Bigg ]}
\newcommand{\Bppn}         [2]  {\Bigg [\frac{\partial^{#2}}{\partial #1^{#2}       }\Bigg ]}
```

```
\newcommand{\Cpp}          [1]  {\Bigg\{\frac{\partial    }{\partial #1             }\Bigg\}}
\newcommand{\Cppp}         [1]  {\Bigg\{\frac{\partial^2  }{\partial #1^2           }\Bigg\}}
\newcommand{\Cpppp}        [2]  {\Bigg\{\frac{\partial^2  }{\partial #1  \partial #2}\Bigg\}}
\newcommand{\Cppn}         [2]  {\Bigg\{\frac{\partial^{#2}}{\partial #1^{#2}       }\Bigg\}}
```

```
\newcommand{\Vpp}          [1]  {\Bigg |\frac{\partial     }{\partial #1              }\Bigg |}
\newcommand{\Vppp}         [1]  {\Bigg |\frac{\partial^2   }{\partial #1^2            }\Bigg |}
\newcommand{\Vpppp}        [2]  {\Bigg |\frac{\partial^2   }{\partial #1   \partial #2}\Bigg |}
\newcommand{\Vppn}         [2]  {\Bigg |\frac{\partial^{#2}}{\partial #1^{#2}         }\Bigg |}
```

```
\newcommand{\Npp}          [1]  {\Bigg\Vert\frac{\partial     }{\partial #1              }\Bigg\Vert}
\newcommand{\Nppp}         [1]  {\Bigg\Vert\frac{\partial^2   }{\partial #1^2            }\Bigg\Vert}
\newcommand{\Npppp}        [2]  {\Bigg\Vert\frac{\partial^2   }{\partial #1   \partial #2}\Bigg\Vert}
\newcommand{\Nppn}         [2]  {\Bigg\Vert\frac{\partial^{#2}}{\partial #1^{#2}         }\Bigg\Vert}
```

Examples

$$\left(\frac{\partial}{\partial x}\right)$$ `\App{x}`

$$\left(\frac{\partial^2}{\partial x^2}\right)$$ `\Appp{x}`

$$\left(\frac{\partial^2}{\partial x \partial y}\right)$$ `\Apppp{x}{y}`

$$\left(\frac{\partial^k}{\partial x^k}\right)$$ `\Appn{x}{k}`

$$\left[\frac{\partial}{\partial x}\right]$$ `\Bpp{x}`

$$\left[\frac{\partial^2}{\partial x^2}\right]$$ `\Bppp{x}`

$$\left[\frac{\partial^2}{\partial x \partial y}\right]$$ `\Bpppp{x}{y}`

$$\left[\frac{\partial^k}{\partial x^k}\right]$$ `\Bppn{x}{k}`

$\left\{ \dfrac{\partial}{\partial x} \right\}$ `\Cpp{x}`

$\left\{ \dfrac{\partial^2}{\partial x^2} \right\}$ `\Cppp{x}`

$\left\{ \dfrac{\partial^2}{\partial x \partial y} \right\}$ `\Cpppp{x}{y}`

$\left\{ \dfrac{\partial^k}{\partial x^k} \right\}$ `\Cppn{x}{k}`

$\left| \dfrac{\partial}{\partial x} \right|$ `\Vpp{x}`

$\left| \dfrac{\partial^2}{\partial x^2} \right|$ `\Vppp{x}`

$\left| \dfrac{\partial^2}{\partial x \partial y} \right|$ `\Vpppp{x}{y}`

$\left| \dfrac{\partial^k}{\partial x^k} \right|$ `\Vppn{x}{k}`

$\left\| \dfrac{\partial}{\partial x} \right\|$ `\Npp{x}`

$\left\| \dfrac{\partial^2}{\partial x^2} \right\|$ `\Nppp{x}`

$\left\| \dfrac{\partial^2}{\partial x \partial y} \right\|$ `\Npppp{x}{y}`

$\left\| \dfrac{\partial^k}{\partial x^k} \right\|$ `\Nppn{x}{k}`

For enlargement of the $(\partial f/\partial x)$-like partial differentiations, I have

Definitions

```
\newcommand{\APp}          [2]  {\Bigg (   \frac{\partial      #1}{\partial #2              }\Bigg )   }
\newcommand{\APPp}         [2]  {\Bigg (   \frac{\partial^2    #1}{\partial #2^2            }\Bigg )   }
\newcommand{\APPpp}        [3]  {\Bigg (   \frac{\partial^2    #1}{\partial #2   \partial #3}\Bigg )   }
\newcommand{\APpn}         [3]  {\Bigg (   \frac{\partial^{#3} #1}{\partial #2^{#3}         }\Bigg )   }
```

```
\newcommand{\BPp}          [2]  {\Bigg [   \frac{\partial      #1}{\partial #2             }\Bigg ]   }
\newcommand{\BPPp}         [2]  {\Bigg [   \frac{\partial^2    #1}{\partial #2 ^2          }\Bigg ]   }
\newcommand{\BPPpp}        [3]  {\Bigg [   \frac{\partial^2    #1}{\partial #2   \partial #3}\Bigg ]   }
\newcommand{\BPpn}         [3]  {\Bigg [   \frac{\partial^{#3} #1}{\partial #2^{#3}        }\Bigg ]   }
```

```
\newcommand{\CPp}          [2]  {\Bigg\{   \frac{\partial      #1}{\partial #2             }\Bigg\}   }
\newcommand{\CPPp}         [2]  {\Bigg\{   \frac{\partial^2    #1}{\partial #2 ^2          }\Bigg\}   }
\newcommand{\CPPpp}        [3]  {\Bigg\{   \frac{\partial^2    #1}{\partial #2   \partial #3}\Bigg\}   }
\newcommand{\CPpn}         [3]  {\Bigg\{   \frac{\partial^{#3} #1}{\partial #2^{#3}        }\Bigg\}   }
```

```
\newcommand{\VPp}          [2]  {\Bigg |   \frac{\partial      #1}{\partial #2             }\Bigg |   }
\newcommand{\VPPp}         [2]  {\Bigg |   \frac{\partial^2    #1}{\partial #2 ^2          }\Bigg |   }
\newcommand{\VPPpp}        [3]  {\Bigg |   \frac{\partial^2    #1}{\partial #2   \partial #3}\Bigg |   }
\newcommand{\VPpn}         [3]  {\Bigg |   \frac{\partial^{#3} #1}{\partial #2^{#3}        }\Bigg |   }
```

```
\newcommand{\NPp}          [2]  {\Bigg\Vert\frac{\partial      #1}{\partial #2             }\Bigg\Vert}
\newcommand{\NPPp}         [2]  {\Bigg\Vert\frac{\partial^2    #1}{\partial #2 ^2          }\Bigg\Vert}
\newcommand{\NPPpp}        [3]  {\Bigg\Vert\frac{\partial^2    #1}{\partial #2   \partial #3}\Bigg\Vert}
\newcommand{\NPpn}         [3]  {\Bigg\Vert\frac{\partial^{#3} #1}{\partial #2^{#3}        }\Bigg\Vert}
```

Examples

$\left(\frac{\partial f}{\partial x}\right)$ `\APp{f}{x}`

$\left(\frac{\partial^2 f}{\partial x^2}\right)$ `\APPp{f}{x}`

$\left(\frac{\partial^2 f}{\partial x \partial y}\right)$ `\APPpp{f}{x}{y}`

$\left(\frac{\partial^k f}{\partial x^k}\right)$ `\APpn{f}{x}{k}`

$$\left[\frac{\partial f(x,y)}{\partial x}\right]$$ `\BPp{f(x,y)}{x}`

$$\left[\frac{\partial^2 f(x,y)}{\partial x^2}\right]$$ `\BPPp{f(x,y)}{x}`

$$\left[\frac{\partial^2 f(x,y)}{\partial x \partial y}\right]$$ `\BPPpp{f(x,y)}{x}{y}`

$$\left[\frac{\partial^k f(x,y)}{\partial x^k}\right]$$ `\BPpn{f(x,y)}{x}{k}`

$$\left\{\frac{\partial f(x,y)}{\partial x}\right\}$$ `\CPp{f(x,y)}{x}`

$$\left\{\frac{\partial^2 f(x,y)}{\partial x^2}\right\}$$ `\CPPp{f(x,y)}{x}`

$$\left\{\frac{\partial^2 f(x,y)}{\partial x \partial y}\right\}$$ `\CPPpp{f(x,y)}{x}{y}`

$$\left\{\frac{\partial^k f(x,y)}{\partial x^k}\right\}$$ `\CPpn{f(x,y)}{x}{k}`

$$\left|\frac{\partial f}{\partial x}\right|$$ `\VPp{f}{x}`

$$\left|\frac{\partial^2 f}{\partial x^2}\right|$$ `\VPPp{f}{x}`

$$\left|\frac{\partial^2 f}{\partial x \partial y}\right|$$ `\VPPpp{f}{x}{y}`

$$\left|\frac{\partial^k f}{\partial x^k}\right|$$ `\VPpn{f}{x}{k}`

$$\left\|\frac{\partial f}{\partial x}\right\|$$ `\NPp{f}{x}`

$$\left\|\frac{\partial^2 f}{\partial x^2}\right\|$$ `\NPPp{f}{x}`

$$\left\|\frac{\partial^2 f}{\partial x \partial y}\right\|$$ `\NPPpp{f}{x}{y}`

$$\left\|\frac{\partial^k f}{\partial x^k}\right\|$$ `\NPpn{f}{x}{k}`

Finally, for simple types of the partial differentiations such like

$(\partial_x f)$

I have also defined some `\newcommand`s as following:

Definitions

```
\newcommand{\ap}          [1]  {\left (    \partial      #1 \right )   }
\newcommand{\apu}         [2]  {\left (    \partial^{#2} #1 \right )   }
\newcommand{\apd}         [2]  {\left (    \partial_{#2} #1 \right )   }
```

```
\newcommand{\bp}          [1]  {\left [    \partial      #1 \right ]   }
\newcommand{\bpu}         [2]  {\left [    \partial^{#2} #1 \right ]   }
\newcommand{\bpd}         [2]  {\left [    \partial_{#2} #1 \right ]   }
```

```
\newcommand{\cp}          [1]  {\left\{    \partial      #1 \right\}   }
\newcommand{\cpu}         [2]  {\left\{    \partial^{#2} #1 \right\}   }
\newcommand{\cpd}         [2]  {\left\{    \partial_{#2} #1 \right\}   }
```

```
\newcommand{\vp}          [1]  {\left |    \partial      #1 \right |   }
\newcommand{\vpu}         [2]  {\left |    \partial^{#2} #1 \right |   }
\newcommand{\vpd}         [2]  {\left |    \partial_{#2} #1 \right |   }
```

```
\newcommand{\np}          [1]  {\left\Vert \partial      #1 \right\Vert}
\newcommand{\npu}         [2]  {\left\Vert \partial^{#2} #1 \right\Vert}
\newcommand{\npd}         [2]  {\left\Vert \partial_{#2} #1 \right\Vert}
```

```
\newcommand{\Sp}          [1]  {\sqrt {    \partial      #1        }   }
\newcommand{\spu}         [2]  {\sqrt {    \partial^{#2} #1        }   }
\newcommand{\spd}         [2]  {\sqrt {    \partial_{#2} #1        }   }
```

where the "u" and "d" stand for "up" and "down" (mean "supscript" and "subscript"), respectively. Note here that the `\newcommand` for $\sqrt{\partial f}$ is `\Sp{f}`, not `\sp{f}`. Because `\sp` and `\sb` have been defined in LaTeX for "supscript" and "subscript"!

Examples

(∂f)	`\ap{f}`
$(\partial^x f)$	`\apu{f}{x}`
$(\partial_x f)$	`\apd{f}{x}`

$[\partial f(x,y)]$	`\bp{f(x,y)}`
$[\partial^x f(x,y)]$	`\bpu{f(x,y)}{x}`
$[\partial_x f(x,y)]$	`\bpd{f(x,y)}{x}`

$\{\partial f(x,y)\}$	`\cp{f(x,y)}`
$\{\partial^x f(x,y)\}$	`\cpu{f(x,y)}{x}`
$\{\partial_x f(x,y)\}$	`\cpd{f(x,y)}{x}`

$\lvert\partial f\rvert$	`\vp{f}`
$\lvert\partial^x f\rvert$	`\vpu{f}{x}`
$\lvert\partial_x f\rvert$	`\vpd{f}{x}`

$\lVert\partial f\rVert$	`\np{f}`
$\lVert\partial^x f\rVert$	`\npu{f}{x}`
$\lVert\partial_x f\rVert$	`\npd{f}{x}`

$\sqrt{\partial f}$	`\Sp{f}`
$\sqrt{\partial^x f}$	`\spu{f}{x}`
$\sqrt{\partial_x f}$	`\spd{f}{x}`

Similar to my "A-B-C-V-N" system for enlargement of the fractions and differentiations, I defined some `\newcommand`s to enlarge the brackets and the norm suck like $[\partial f(x,y)]$ and $\lvert\partial f\rvert$.

Definitions

```
\newcommand{\Ap}          [1]  {\Big (    \partial      #1 \Big )   }
\newcommand{\Apu}         [2]  {\Big (    \partial^{#2} #1 \Big )   }
\newcommand{\Apd}         [2]  {\Big (    \partial_{#2} #1 \Big )   }
```

```
\newcommand{\Bp}          [1]  {\Big [    \partial      #1 \Big ]   }
\newcommand{\Bpu}         [2]  {\Big [    \partial^{#2} #1 \Big ]   }
\newcommand{\Bpd}         [2]  {\Big [    \partial_{#2} #1 \Big ]   }
```

```
\newcommand{\Cp}          [1]  {\Big\{    \partial      #1 \Big\}   }
\newcommand{\Cpu}         [2]  {\Big\{    \partial^{#2} #1 \Big\}   }
\newcommand{\Cpd}         [2]  {\Big\{    \partial_{#2} #1 \Big\}   }
```

```
\newcommand{\Vp}          [1]  {\Big |    \partial      #1 \Big |   }
\newcommand{\Vpu}         [2]  {\Big |    \partial^{#2} #1 \Big |   }
\newcommand{\Vpd}         [2]  {\Big |    \partial_{#2} #1 \Big |   }
```

```
\newcommand{\Np}          [1]  {\Big\Vert \partial      #1 \Big\Vert}
\newcommand{\Npu}         [2]  {\Big\Vert \partial^{#2} #1 \Big\Vert}
\newcommand{\Npd}         [2]  {\Big\Vert \partial_{#2} #1 \Big\Vert}
```

Note that the "A, B, C, V, and N" here stand not for the largest commands `\Bigg` but for the larger ones `\Big`.

Examples

$\Big(\partial f\Big)$ `\Ap{f}`

$\Big(\partial^x f\Big)$ `\Apu{f}{x}`

$\Big(\partial_x f\Big)$ `\Apd{f}{x}`

$\Big[\partial f(x,y)\Big]$ `\Bp{f(x,y)}`

$\Big[\partial^x f(x,y)\Big]$ `\Bpu{f(x,y)}{x}`

$\Big[\partial_x f(x,y)\Big]$ `\Bpd{f(x,y)}{x}`

$\Big\{\partial f(x,y)\Big\}$ `\Cp{f(x,y)}`

$\Big\{\partial^x f(x,y)\Big\}$ `\Cpu{f(x,y)}{x}`

$\Big\{\partial_x f(x,y)\Big\}$ `\Cpd{f(x,y)}{x}`

$\Big|\partial f\Big|$ `\Vp{f}`

$\Big|\partial^x f\Big|$ `\Vpu{f}{x}`

$\Big|\partial_x f\Big|$ `\Vpd{f}{x}`

$\Big\|\partial f\Big\|$ `\Np{f}`

$\Big\|\partial^x f\Big\|$ `\Npu{f}{x}`

$\Big\|\partial_x f\Big\|$ `\Npd{f}{x}`

2.8 Operators involving ∇ [†]

The \newcommands for the basic operators involving ∇ have been defined as

Definitions

```
\newcommand{\del}               {\nabla}
\newcommand{\Grad}              {\nabla}
\newcommand{\Div}               {\nabla\cdot}
\newcommand{\Curl}              {\nabla\times}
\newcommand{\Lap}               {\nabla^2}
```

Examples

∇	\del
∇	\Grad
$\nabla\cdot$	\Div
$\nabla\times$	\Curl
∇^2	\Lap

Certainly, I have also some useful \newcommands for the usual use of the operators in a bracket, in a square root or in simple types. The \del family,

Definitions

```
\newcommand{\adel}          [1]  {\left (    \nabla      #1 \right )   }
\newcommand{\adelu}         [2]  {\left (    \nabla^{#2} #1 \right )   }
\newcommand{\adeld}         [2]  {\left (    \nabla_{#2} #1 \right )   }
```

```
\newcommand{\bdel}          [1]  {\left [    \nabla      #1 \right ]   }
\newcommand{\bdelu}         [2]  {\left [    \nabla^{#2} #1 \right ]   }
\newcommand{\bdeld}         [2]  {\left [    \nabla_{#2} #1 \right ]   }
```

```
\newcommand{\cdel}          [1]  {\left\{    \nabla      #1 \right\}   }
\newcommand{\cdelu}         [2]  {\left\{    \nabla^{#2} #1 \right\}   }
\newcommand{\cdeld}         [2]  {\left\{    \nabla_{#2} #1 \right\}   }
```

[†] Fresh defined \newcommands

```
\newcommand{\vdel}        [1]  {\left |    \nabla      #1 \right |   }
\newcommand{\vdelu}       [2]  {\left |    \nabla^{#2} #1 \right |   }
\newcommand{\vdeld}       [2]  {\left |    \nabla_{#2} #1 \right |   }
```

```
\newcommand{\ndel}        [1]  {\left\Vert \nabla      #1 \right\Vert}
\newcommand{\ndelu}       [2]  {\left\Vert \nabla^{#2} #1 \right\Vert}
\newcommand{\ndeld}       [2]  {\left\Vert \nabla_{#2} #1 \right\Vert}
```

```
\newcommand{\sdel}        [1]  {\sqrt {    \nabla      #1        }   }
\newcommand{\sdelu}       [2]  {\sqrt {    \nabla^{#2} #1        }   }
\newcommand{\sdeld}       [2]  {\sqrt {    \nabla_{#2} #1        }   }
```

Examples

(∇f)	`\adel{f}`
$(\nabla^x f)$	`\adelu{f}{x}`
$(\nabla_x f)$	`\adeld{f}{x}`

$[\nabla f(x,y)]$	`\bdel{f(x,y)}`
$[\nabla^x f(x,y)]$	`\bdelu{f(x,y)}{x}`
$[\nabla_x f(x,y)]$	`\bdeld{f(x,y)}{x}`

$\{\nabla f(x,y)\}$	`\cdel{f(x,y)}`
$\{\nabla^x f(x,y)\}$	`\cdelu{f(x,y)}{x}`
$\{\nabla_x f(x,y)\}$	`\cdeld{f(x,y)}{x}`

$\lvert\nabla f\rvert$	`\vdel{f}`
$\lvert\nabla^x f\rvert$	`\vdelu{f}{x}`
$\lvert\nabla_x f\rvert$	`\vdeld{f}{x}`

$\lVert\nabla f\rVert$	`\ndel{f}`
$\lVert\nabla^x f\rVert$	`\ndelu{f}{x}`
$\lVert\nabla_x f\rVert$	`\ndeld{f}{x}`

$\sqrt{\nabla f}$	`\sdel{f}`
$\sqrt{\nabla^x f}$	`\sdelu{f}{x}`
$\sqrt{\nabla_x f}$	`\sdeld{f}{x}`

For enlargement of the `\del` family, I defined

Definitions

```
\newcommand{\Adel}         [1]  {\Big (    \nabla      #1 \Big )   }
\newcommand{\Adelu}        [2]  {\Big (    \nabla^{#2} #1 \Big )   }
\newcommand{\Adeld}        [2]  {\Big (    \nabla_{#2} #1 \Big )   }
```

```
\newcommand{\Bdel}         [1]  {\Big [    \nabla      #1 \Big ]   }
\newcommand{\Bdelu}        [2]  {\Big [    \nabla^{#2} #1 \Big ]   }
\newcommand{\Bdeld}        [2]  {\Big [    \nabla_{#2} #1 \Big ]   }
```

```
\newcommand{\Cdel}         [1]  {\Big\{    \nabla      #1 \Big\}   }
\newcommand{\Cdelu}        [2]  {\Big\{    \nabla^{#2} #1 \Big\}   }
\newcommand{\Cdeld}        [2]  {\Big\{    \nabla_{#2} #1 \Big\}   }
```

```
\newcommand{\Vdel}         [1]  {\Big |    \nabla      #1 \Big |   }
\newcommand{\Vdelu}        [2]  {\Big |    \nabla^{#2} #1 \Big |   }
\newcommand{\Vdeld}        [2]  {\Big |    \nabla_{#2} #1 \Big |   }
```

```
\newcommand{\Ndel}         [1]  {\Big\Vert \nabla      #1 \Big\Vert}
\newcommand{\Ndelu}        [2]  {\Big\Vert \nabla^{#2} #1 \Big\Vert}
\newcommand{\Ndeld}        [2]  {\Big\Vert \nabla_{#2} #1 \Big\Vert}
```

Note that the "A, B, C, V, and N" here stand not for the largest commands `\Bigg` but for the larger ones `\Big`.

Examples

$\Big(\nabla f\Big)$	`\Adel{f}`
$\Big(\nabla^x f\Big)$	`\Adelu{f}{x}`
$\Big(\nabla_x f\Big)$	`\Adeld{f}{x}`

$\left[\nabla f(x,y)\right]$	`\Bdel{f(x,y)}`
$\left[\nabla^{x} f(x,y)\right]$	`\Bdelu{f(x,y)}{x}`
$\left[\nabla_{x} f(x,y)\right]$	`\Bdeld{f(x,y)}{x}`

$\left\{\nabla f(x,y)\right\}$	`\Cdel{f(x,y)}`
$\left\{\nabla^{x} f(x,y)\right\}$	`\Cdelu{f(x,y)}{x}`
$\left\{\nabla_{x} f(x,y)\right\}$	`\Cdeld{f(x,y)}{x}`

$\left\lvert\nabla f\right\rvert$	`\Vdel{f}`
$\left\lvert\nabla^{x} f\right\rvert$	`\Vdelu{f}{x}`
$\left\lvert\nabla_{x} f\right\rvert$	`\Vdeld{f}{x}`

$\left\lVert\nabla f\right\rVert$	`\Ndel{f}`
$\left\lVert\nabla^{x} f\right\rVert$	`\Ndelu{f}{x}`
$\left\lVert\nabla_{x} f\right\rVert$	`\Ndeld{f}{x}`

The `\Grad` family,

Definitions

```
\newcommand{\aGrad}       [1]  {\left (    \nabla      #1 \right )   }
\newcommand{\aGradu}      [2]  {\left (    \nabla^{#2} #1 \right )   }
\newcommand{\aGradd}      [2]  {\left (    \nabla_{#2} #1 \right )   }
```

```
\newcommand{\bGrad}       [1]  {\left [    \nabla      #1 \right ]   }
\newcommand{\bGradu}      [2]  {\left [    \nabla^{#2} #1 \right ]   }
\newcommand{\bGradd}      [2]  {\left [    \nabla_{#2} #1 \right ]   }
```

```
\newcommand{\cGrad}       [1]  {\left\{    \nabla      #1 \right\}   }
\newcommand{\cGradu}      [2]  {\left\{    \nabla^{#2} #1 \right\}   }
\newcommand{\cGradd}      [2]  {\left\{    \nabla_{#2} #1 \right\}   }
```

```
\newcommand{\vGrad}        [1]  {\left |    \nabla      #1 \right |   }
\newcommand{\vGradu}       [2]  {\left |    \nabla^{#2} #1 \right |   }
\newcommand{\vGradd}       [2]  {\left |    \nabla_{#2} #1 \right |   }
```

```
\newcommand{\nGrad}        [1]  {\left\Vert \nabla      #1 \right\Vert}
\newcommand{\nGradu}       [2]  {\left\Vert \nabla^{#2} #1 \right\Vert}
\newcommand{\nGradd}       [2]  {\left\Vert \nabla_{#2} #1 \right\Vert}
```

```
\newcommand{\sGrad}        [1]  {\sqrt {    \nabla      #1        }   }
\newcommand{\sGradu}       [2]  {\sqrt {    \nabla^{#2} #1        }   }
\newcommand{\sGradd}       [2]  {\sqrt {    \nabla_{#2} #1        }   }
```

Examples

(∇f)	`\aGrad{f}`
$(\nabla^x f)$	`\aGradu{f}{x}`
$(\nabla_x f)$	`\aGradd{f}{x}`

$[\nabla f(x,y)]$	`\bGrad{f(x,y)}`
$[\nabla^x f(x,y)]$	`\bGradu{f(x,y)}{x}`
$[\nabla_x f(x,y)]$	`\bGradd{f(x,y)}{x}`

$\{\nabla f(x,y)\}$	`\cGrad{f(x,y)}`
$\{\nabla^x f(x,y)\}$	`\cGradu{f(x,y)}{x}`
$\{\nabla_x f(x,y)\}$	`\cGradd{f(x,y)}{x}`

$\lvert\nabla f\rvert$	`\vGrad{f}`
$\lvert\nabla^x f\rvert$	`\vGradu{f}{x}`
$\lvert\nabla_x f\rvert$	`\vGradd{f}{x}`

$\lVert\nabla f\rVert$	`\nGrad{f}`
$\lVert\nabla^x f\rVert$	`\nGradu{f}{x}`
$\lVert\nabla_x f\rVert$	`\nGradd{f}{x}`

$\sqrt{\nabla f}$	`\sGrad{f}`
$\sqrt{\nabla^x f}$	`\sGradu{f}{x}`
$\sqrt{\nabla_x f}$	`\sGradd{f}{x}`

For enlargement of the `\Grad` family, I defined

Definitions

```
\newcommand{\AGrad}       [1]  {\Big (    \nabla      #1 \Big )   }
\newcommand{\AGradu}      [2]  {\Big (    \nabla^{#2} #1 \Big )   }
\newcommand{\AGradd}      [2]  {\Big (    \nabla_{#2} #1 \Big )   }
```

```
\newcommand{\BGrad}       [1]  {\Big [    \nabla      #1 \Big ]   }
\newcommand{\BGradu}      [2]  {\Big [    \nabla^{#2} #1 \Big ]   }
\newcommand{\BGradd}      [2]  {\Big [    \nabla_{#2} #1 \Big ]   }
```

```
\newcommand{\CGrad}       [1]  {\Big\{    \nabla      #1 \Big\}   }
\newcommand{\CGradu}      [2]  {\Big\{    \nabla^{#2} #1 \Big\}   }
\newcommand{\CGradd}      [2]  {\Big\{    \nabla_{#2} #1 \Big\}   }
```

```
\newcommand{\VGrad}       [1]  {\Big |    \nabla      #1 \Big |   }
\newcommand{\VGradu}      [2]  {\Big |    \nabla^{#2} #1 \Big |   }
\newcommand{\VGradd}      [2]  {\Big |    \nabla_{#2} #1 \Big |   }
```

```
\newcommand{\NGrad}       [1]  {\Big\Vert \nabla      #1 \Big\Vert}
\newcommand{\NGradu}      [2]  {\Big\Vert \nabla^{#2} #1 \Big\Vert}
\newcommand{\NGradd}      [2]  {\Big\Vert \nabla_{#2} #1 \Big\Vert}
```

Examples

$\Big(\nabla f\Big)$	`\AGrad{f}`
$\Big(\nabla^x f\Big)$	`\AGradu{f}{x}`
$\Big(\nabla_x f\Big)$	`\AGradd{f}{x}`

$\left[\nabla f(x,y)\right]$	`\BGrad{f(x,y)}`
$\left[\nabla^x f(x,y)\right]$	`\BGradu{f(x,y)}{x}`
$\left[\nabla_x f(x,y)\right]$	`\BGradd{f(x,y)}{x}`

$\left\{\nabla f(x,y)\right\}$	`\CGrad{f(x,y)}`
$\left\{\nabla^x f(x,y)\right\}$	`\CGradu{f(x,y)}{x}`
$\left\{\nabla_x f(x,y)\right\}$	`\CGradd{f(x,y)}{x}`

$\left\lvert\nabla f\right\rvert$	`\VGrad{f}`
$\left\lvert\nabla^x f\right\rvert$	`\VGradu{f}{x}`
$\left\lvert\nabla_x f\right\rvert$	`\VGradd{f}{x}`

$\left\lVert\nabla f\right\rVert$	`\NGrad{f}`
$\left\lVert\nabla^x f\right\rVert$	`\NGradu{f}{x}`
$\left\lVert\nabla_x f\right\rVert$	`\NGradd{f}{x}`

Furthermore, for the normal and enlarged `\Div` family,

Definitions

```
\newcommand{\aDiv}        [1]  {\left (    \nabla\cdot #1 \right )   }
\newcommand{\bDiv}        [1]  {\left [    \nabla\cdot #1 \right ]   }
\newcommand{\cDiv}        [1]  {\left\{    \nabla\cdot #1 \right\}   }
```

```
\newcommand{\vDiv}        [1]  {\left |    \nabla\cdot #1 \right |   }
\newcommand{\nDiv}        [1]  {\left\Vert \nabla\cdot #1 \right\Vert}
\newcommand{\sDiv}        [1]  {\sqrt {    \nabla\cdot #1        }   }
```

```
\newcommand{\ADiv}        [1]  {\Big  (    \nabla\cdot #1 \Big   )   }
\newcommand{\BDiv}        [1]  {\Big  [    \nabla\cdot #1 \Big   ]   }
\newcommand{\CDiv}        [1]  {\Big \{    \nabla\cdot #1 \Big  \}   }
```

```
\newcommand{\VDiv}         [1]  {\Big  |    \nabla\cdot #1 \Big   |   }
\newcommand{\NDiv}         [1]  {\Big \Vert \nabla\cdot #1 \Big  \Vert}
```

Examples

$(\nabla \cdot \mathbf{A})$ `\aDiv{\bf A}`

$[\nabla \cdot (f\mathbf{A})]$ `\bDiv{(f {\bf A})}`

$\{\nabla \cdot (f\mathbf{A})\}$ `\cDiv{(f {\bf A})}`

$|\nabla \cdot \mathbf{A}|$ `\vDiv{\bf A}`

$\|\nabla \cdot \mathbf{A}\|$ `\nDiv{\bf A}`

$\sqrt{\nabla \cdot \mathbf{A}}$ `\sDiv{\bf A}`

$\left(\nabla \cdot \mathbf{A}\right)$ `\ADiv{\bf A}`

$\left[\nabla \cdot (f\mathbf{A})\right]$ `\BDiv{(f {\bf A})}`

$\left\{\nabla \cdot (f\mathbf{A})\right\}$ `\CDiv{(f {\bf A})}`

$\left|\nabla \cdot \mathbf{A}\right|$ `\VDiv{\bf A}`

$\left\|\nabla \cdot \mathbf{A}\right\|$ `\NDiv{\bf A}`

For the normal and enlarged `\Curl` family,

Definitions

```
\newcommand{\aCurl}        [1]  {\left (    \nabla\times #1 \right )   }
\newcommand{\bCurl}        [1]  {\left [    \nabla\times #1 \right ]   }
\newcommand{\cCurl}        [1]  {\left\{    \nabla\times #1 \right\}   }
```

```
\newcommand{\vCurl}        [1]  {\left |    \nabla\times #1 \right |   }
\newcommand{\nCurl}        [1]  {\left\Vert \nabla\times #1 \right\Vert}
\newcommand{\sCurl}        [1]  {\sqrt {    \nabla\times #1        }   }
```

```
\newcommand{\ACurl}        [1]  {\Big  (    \nabla\times #1 \Big   )   }
\newcommand{\BCurl}        [1]  {\Big  [    \nabla\times #1 \Big   ]   }
\newcommand{\CCurl}        [1]  {\Big \{    \nabla\times #1 \Big  \}   }
```

```
\newcommand{\VCurl}       [1]  {\Big  |    \nabla\times #1 \Big   |   }
\newcommand{\NCurl}       [1]  {\Big \Vert \nabla\times #1 \Big  \Vert}
```

Examples

$(\nabla \times \mathbf{A})$	`\aCurl{\bf A}`
$[\nabla \times (f\mathbf{A})]$	`\bCurl{(f {\bf A})}`
$\{\nabla \times (f\mathbf{A})\}$	`\cCurl{(f {\bf A})}`

$\lvert\nabla \times \mathbf{A}\rvert$	`\vCurl{\bf A}`
$\lVert\nabla \times \mathbf{A}\rVert$	`\nCurl{\bf A}`
$\sqrt{\nabla \times \mathbf{A}}$	`\sCurl{\bf A}`

$\left(\nabla \times \mathbf{A}\right)$	`\ACurl{\bf A}`
$\left[\nabla \times (f\mathbf{A})\right]$	`\BCurl{(f {\bf A})}`
$\left\{\nabla \times (f\mathbf{A})\right\}$	`\CCurl{(f {\bf A})}`

$\left\lvert\nabla \times \mathbf{A}\right\rvert$	`\VCurl{\bf A}`
$\left\lVert\nabla \times \mathbf{A}\right\rVert$	`\NCurl{\bf A}`

And for the normal and enlarged `\Lap` family,

Definitions

```
\newcommand{\aLap}        [1]  {\left (    \nabla\^2 #1 \right )   }
\newcommand{\bLap}        [1]  {\left [    \nabla\^2 #1 \right ]   }
\newcommand{\cLap}        [1]  {\left\{    \nabla\^2 #1 \right\}   }
```

```
\newcommand{\vLap}        [1]  {\left |    \nabla\^2 #1 \right |   }
\newcommand{\nLap}        [1]  {\left\Vert \nabla\^2 #1 \right\Vert}
\newcommand{\sLap}        [1]  {\sqrt {    \nabla\^2 #1        }   }
```

```
\newcommand{\ALap}        [1]  {\Big  (    \nabla\^2 #1 \Big   )   }
\newcommand{\BLap}        [1]  {\Big  [    \nabla\^2 #1 \Big   ]   }
\newcommand{\CLap}        [1]  {\Big \{    \nabla\^2 #1 \Big  \}   }
```

```
\newcommand{\VLap}         [1]  {\Big  |    \nabla\^2 #1 \Big   |   }
\newcommand{\NLap}         [1]  {\Big \Vert \nabla\^2 #1 \Big  \Vert}
```

Examples

$\left(\nabla^2\mathbf{A}\right)$ `\aLap{\bf A}`

$\left[\nabla^2(f\mathbf{A})\right]$ `\bLap{(f {\bf A})}`

$\left\{\nabla^2(f\mathbf{A})\right\}$ `\cLap{(f {\bf A})}`

$\left|\nabla^2\mathbf{A}\right|$ `\vLap{\bf A}`

$\left\|\nabla^2\mathbf{A}\right\|$ `\nLap{\bf A}`

$\sqrt{\nabla^2\mathbf{A}}$ `\sLap{\bf A}`

$\left(\nabla^2\mathbf{A}\right)$ `\ALap{\bf A}`

$\left[\nabla^2(f\mathbf{A})\right]$ `\BLap{(f {\bf A})}`

$\left\{\nabla^2(f\mathbf{A})\right\}$ `\CLap{(f {\bf A})}`

$\left|\nabla^2\mathbf{A}\right|$ `\VLap{\bf A}`

$\left\|\nabla^2\mathbf{A}\right\|$ `\NLap{\bf A}`

2.9 Arrows

Almost all of the original LaTeX commands for the different arrow types in different directions are too long for a lazy man like me, except these two: `\gets` and `\to` (for ← and →). Therefore, I decided to give them shorter names. At the same time I also extended the "arrow" system.

Definitions

```
\newcommand{\lgets}            {\longleftarrow}
\newcommand{\Lgets}            {\longleftarrow \!\!\!- \!\!\!- \!\!\!-}
```

```
\newcommand{\Gets}             {\Leftarrow}
\newcommand{\lGets}            {\Longleftarrow}
\newcommand{\LGets}            {\Longleftarrow \!= \!= \!=}
```

Here the capital "G" stands for a arrow "with double line", and the small "l" and capital "L" stand for a "longer" and the "longest" arrows.

Examples

$\longleftarrow$	\lgets
$\Longleftarrow$	\Lgets

$\Leftarrow$	\Gets
$\Longleftarrow$	\lGets
$\Longleftarrow$	\LGets

For the arrows towards to right side, you just need to change the "gets" or "Gets" to "to" or "To", respectively:

Definitions

```
\newcommand{\lto}              {\longrightarrow}
\newcommand{\Lto}              {-\!\!\! -\!\!\! -\!\!\! \longrightarrow}
```

```
\newcommand{\To}               {\Rightarrow}
\newcommand{\lTo}              \Longrightarrow}
\newcommand{\LTo}              {=\! =\! =\! \Longrightarrow}
```

Examples

$\longrightarrow$	\lto
$\Longrightarrow$	\Lto

$\Rightarrow$	\To
$\Longrightarrow$	\lTo
$\Longrightarrow$	\LTo

Combine "gets" with "to" or "Gets" with "To", you have now the double-head arrows,

Definitions

```
\newcommand{\getsto}           {\leftrightarrow}
\newcommand{\lgetsto}          {\longleftrightarrow}
\newcommand{\Lgetsto}          {\longleftarrow \! \longrightarrow}
```

```
\newcommand{\Getsto}            {\Leftrightarrow}
\newcommand{\lGetsto}           {\Longleftrightarrow}
\newcommand{\LGetsto}           {\Longleftarrow \! \Longrightarrow}
```

Note that you don't need to (*can not*) write a command such like `\GetsTo` or `\LGetsTo` for a double-line arrow.

Examples

$\leftrightarrow$	`\getsto`
$\longleftrightarrow$	`\lgetsto`
$\Longleftrightarrow$	`\Lgetsto`

$\Leftrightarrow$	`\Getsto`
$\Longleftrightarrow$	`\lGetsto`
$\Longleftrightarrow$	`\LGetsto`

Moreover, it seems for the (elementary particle) physicists very convenient and simpler to remember if we rename the upward and downward arrows as spin "up" and spin "down":

Definitions

```
\newcommand{\spinU}             {\uparrow}
\newcommand{\spinD}             {\downarrow}
```

Examples

$\uparrow$	`\spinU`
$\downarrow$	`\spinD`

2.10 Bras, kets and expectation values

In quantum mechanics we use very often the "bra" and "ket" symbols: $\langle x|$ and $|x\rangle$, it is for sure worth to define some `\newcommand`s for them:

Definitions

```
\newcommand{\bra}           [1]  {\langle {\textstyle{#1}} |      }
\newcommand{\ket}           [1]  {      | {\textstyle{#1}} \rangle}
```

```
\newcommand{\Bra}           [1]  {\left< {          {#1}} \right|}
\newcommand{\Ket}           [1]  {\left| {          {#1}} \right>}
```

As usual, I used here the capital "B" and "K" for the cases with larger arguments.

Examples

$\langle\psi\|$	`\bra{\psi}`
$\|\psi\rangle$	`\ket{\psi}`

$\langle\psi^0\|$	`\Bra{\psi^0}`
$\|\psi^0\rangle$	`\Ket{\psi^0}`

Certainly, I considered the cases of the bra and ket symbols with two or three arguments.

Definitions

```
\newcommand{\Ylmstar}      [2]  {\langle{\textstyle{#1}^{#2}     }|      }
\newcommand{\Ylm}          [2]  {      |{\textstyle{#1}^{#2}     }\rangle}
```

```
\newcommand{\nlmstar}      [3]  {\langle{\textstyle{#1}^{#2}^{#3}}|      }
\newcommand{\nlm}          [3]  {      |{\textstyle{#1}^{#2}^{#3}}\rangle}
```

where I also borrowed the terminology from quantum mechanics and "star" stands for the $*$ as a supscript (indicates a conjugate partner in QM).

Examples

$\langle l\ m\|$	`\Ylmstar{l}{m}`
$\|l\ m\rangle$	`\Ylm{l}{m}`

$\langle n\ l\ m\|$	`\nlmstar{n}{l}{m}`
$\|n\ l\ m\rangle$	`\nlm{n}{l}{m}`

Moreover, I defined some `\newcommand`s for the inner product of a pair bra and ket and for expectation values:

Definitions

```
\newcommand{\braket}       [2]  {\langle{\textstyle{#1}     |{#2}          }\rangle}
\newcommand{\innerP}       [2]  {\langle{\textstyle{#1}     |{#2}          }\rangle}
```

```
\newcommand{\expv}         [1]  {\langle{\textstyle          {#1}          }\rangle}
\newcommand{\Expv}         [1]  {\left<                      {#1}           \right>}
```

```
\newcommand{\expV}        [3]  {\langle{\textstyle{#1}     |{#2}|      {#3}}\rangle}
\newcommand{\ExpV}        [3]  {\left<            {#1}\left|{#2}\right|{#3} \right>}
```

Here the capital "E" stands for the larger argument or arguments, and the small "v" or the capital "V" stand for "without" or "with" the two wave functions.

Examples

$\langle\psi\|\phi\rangle$	`\braket{\psi}{\phi}`
$\langle\psi\|\phi\rangle$	`\innerP{\psi}{\phi}`

$\langle x\rangle$	`\expv{x}`
$\left\langle \frac{p^2}{2m} \right\rangle$	`\Expv{\frac{p^2}{2m}}`

$\langle\psi\|x\|\phi\rangle$	`\expV{\psi}{x}{\phi}`
$\left\langle \psi \middle\| \frac{p^2}{2m} \middle\| \psi \right\rangle$	`\ExpV{\psi}{\frac{p^2}{2m}}{\phi}`

2.11 Atomic symbols [†]

For the atomic symbols such like ${}^{A}X$ or ${}^{A}_{Z}X$, I defined the following `\newcommand`s:

Definitions

```
\newcommand{\XA}          [2]  {\sp{#2}       {    #1}}
\newcommand{\XAZ}         [3]  {\sp{#2}\sb{#3}{    #1}}
```

```
\newcommand{\rmXA}        [2]  {\sp{#2}       {\rm #1}}
\newcommand{\rmXAZ}       [3]  {\sp{#2}\sb{#3}{\rm #1}}
```

```
\newcommand{\bfXA}        [2]  {\sp{#2}       {\bf #1}}
\newcommand{\bfXAZ}       [3]  {\sp{#2}\sb{#3}{\bf #1}}
```

Here the "X", "A", and "Z" stand for the name, the atomic number, and the number of protons of the element, and, as usual, I used "rm" and "bf" for the "roman" and "bold face" print types. Note that I modified the definitions of the above `\newcommand`s in `Version 4.0`, but the commands and results are unchanged. Thus, if you use my `CLShanCommands-Math.tex` file or `clshan-math` package directly, you have to worry about nothing!

[†] Fresh defined `\newcommand`s

Examples

^{4}He	`\XA{He}{4}`
$^{4}_{2}He$	`\XAZ{He}{4}{2}`

$^{4}\mathrm{He}$	`\rmXA{He}{4}`
$^{4}_{2}\mathrm{He}$	`\rmXAZ{He}{4}{2}`

$^{4}\mathbf{He}$	`\bfXA{He}{4}`
$^{4}_{2}\mathbf{He}$	`\bfXAZ{He}{4}{2}`

Note here that, if you want to type some elements such like $^{12}_{6}C$ or $^{127}_{53}I$, you need to type `\~` for a small space in the third (lower) parameter: `$\XAZ{C}{12}{\~6}$`, `$\XAZ{I}{127}{\~53}$`. On the other hand, for some special expressions in the nuclear physics, I have

Definitions

```
\newcommand{\slj}          [3]  {       \sp{#1} {#2}_{#3}}
\newcommand{\nslj}         [4]  {{#1}~\!\sp{#2} {#3}_{#4}}
```

Note that the definitions of the above `\newcommand`s have been also modified in `Version 4.0`.

Examples

^{2}P	`\slj{2}{P}{}`
$^{2}P_{1/2}$	`\slj{2}{P}{1/2}`
$2\,^{1}S_{0}$	`\nslj{2}{1}{S}{0}`

And, for the "norder" symbol in the quantum field theory,

Definition

```
\newcommand{\Norder}       [1]  {:\!#1\!:}
```

Example

$:\phi_1:$	`\Norder{\phi_1}`

2.12 Traces

In the quantum field theory, the trace of a matrix or a product of a few matrices has been always calculated. This means that I should define some shorter commands for them.

Definitions

```
\newcommand{\tr}                {{\it tr}}
\newcommand{\Tr}                {{\it Tr}}
```

```
\newcommand{\rmtr}              {{\rm tr}}
\newcommand{\rmTr}              {{\rm Tr}}
```

```
\newcommand{\bftr}              {{\bf tr}}
\newcommand{\bfTr}              {{\bf Tr}}
```

where the "rm" and "bf" stand for "roman" and "bold face" print types.

Examples

tr	`\tr`
Tr	`\Tr`

tr	`\rmtr`
Tr	`\rmTr`

tr	`\bftr`
Tr	`\bfTr`

2.13 Slashs

Like the `Tr`s, in the quantum field theory and the elementary particle physics, you can always find some "slash"s of 4-momenta. So, just define some `\newcommand`s:

Definitions

```
\newcommand{\xslash}       [1]  {\mbox{$\not{\hspace{-0.4ex} #1     }$}}
\newcommand{\xpslash}      [1]  {\mbox{$\not{\hspace{-0.4ex} #1 \~' }$}}
\newcommand{\xdpslash}     [1]  {\mbox{$\not{\hspace{-0.4ex} #1 \~''}$}}
```

Here "p" stands for "prime" and "dp" stands for "double prime".

Examples

$\not{k}$	`\xslash{k}`
$\not{p}'$	`\xpslash{p}`
$\not{q}''$	`\xdpslash{q}`

2.14 `\eliminate` and `\equalto`

Sometimes we want to show an elimination clearly such like

$$\sqrt{Q}\left[\frac{1}{F^2(Q)}\left(\frac{dR}{dQ}\right)\right]_0^{\overset{0}{\nearrow}\infty} - \frac{1}{2}\int_0^\infty \frac{1}{\sqrt{Q}}\left[\frac{1}{F^2(Q)}\left(\frac{dR}{dQ}\right)\right]dQ$$

My German colleague in the Physikalisches Institut der Universität Bonn, Markus Bernhardt, asked me for a solution and one day later I gave him my definition:

Definition

```
\newcommand{\eliminate}    [6]  {\raisebox{0.5ex}{
                                 \begin{picture}(#2,0)
                                 \put(0,0){\makebox(#2,#6){$\D #1$}}
                                 \put(0,0){\makebox(#2,#6){\vector(#3,1){#4}}}
                                 \put(0,0){\makebox(#2,#5){\hspace{#4 cm}
                                                           \hspace{1em}{\small 0}}}
                                 \end{picture}
                                 }}
```

Here the parameters have been defined as

Parameters

#1: the part in this equation which you want to "eliminate".
#2: the width of this part in the equation.
#3: the direction of the arrow, there are four choices: 1, 2, 3, 4.
#4: the length of the projection of the arrow in the x-axis, usually can be set to be equal to #3.
#5: the height of the "0", usually can be set to be between "0.9" and "1.2".
#6: a fine tune of the position, usually can be set to be between "0" and "0.1".

Note that, the suggestions for values of the parameter #4, #5, and #6 here can not be suitable for every case, I just want to give you an idea how large these values could approximately be, so that you can adjust them more easily. As a good example I give you here the command which I used for the first part of the equation above:

Example

```
\eliminate{\sqrt{Q} \left[......\right]}{3.32}{2}{3}{1.6}{0.05}
```

Similarly, sometimes we want to show a simple value, for example 1 or -1, of a complicate part of one equation more clearly, then we can use a `\newcommand` defined as

Definition

```
\newcommand{\equalto}      [7]  {\raisebox{0.5ex}{
                                 \begin{picture}(#3,0)
                                 \put(0,0){\makebox(#3,#7){$\D #1$}}
                                 \put(0,0){\makebox(#3,#7){\vector(#4,1){#5}}}
                                 \put(0,0){\makebox(#3,#6){\hspace{#5 cm}
                                                           \hspace{1em}{\small #2}}}
                                 \end{picture}
                                 }}
```

Here the parameters have been defined as

Parameters

#1: the part in this equation which is "equal to" a special value.
#2: the value to which this part in the equation is equal.
#3: the width of this part in the equation.
#4: the direction of the arrow, there are four choices: 1, 2, 3, 4.
#5: the length of the projection of the arrow in the x-axis, usually can be set to be equal to #4.
#6: the height of "#2", usually can be set to be between "0.9" and "1.2".
#7: a fine tune of the position, usually can be set to be between "0" and "0.1".

Note that, first, values of the parameter #4, #5, and #6 given here are just suggestions, second, the value which you want to specify must be given as the "second" parameter (#2). Then the command in the example for `\eliminate` can be now rewritten as

Example

```
\equalto{\sqrt{Q} \left[......\right]}{0}{3.32}{2}{3}{1.6}{0.05}
```

2.15 Miscellanea

For the geometry, we need some expressions such like $\overline{AB}$ or $A_{/\!/}$. I'm too lazy to type long commands but like to give then a new (and shorter) name.

Definitions

```
\newcommand{\Line}              {\overline}

\newcommand{\para}              {{/\!\!/}}
```

Examples

$\overline{AB}$	`\Line{AB}`
$A_{/\!/}$	`A_{\para}`

Similarly, I also defined a shorter `\newcommand` for the summation symbol with two subscripts:

Definition

```
\newcommand{\sumd}          [2]  {\sum_{\stackrel{\scriptstyle #1}{#2}}}
```

where the "d" stands for "double" subscripts.

Example

$\sum_{\substack{i=1 \\ i \neq j}}^{N}$	`\sumd{i=1}{i \ne j}^{N}`

3 Matrices

I also defined a few basic matrices in quantum mechanics and high energy physics.

3.1 Identity matrices

The 2×2, 3×3, and 4×4 identity matrices:

$$\mathbf{I}_2 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \qquad \texttt{\textbackslash Identityb}$$

$$\mathbf{I}_3 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \qquad \texttt{\textbackslash Identityc}$$

$$\mathbf{I}_4 = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \qquad \texttt{\textbackslash Identityd}$$

have been defined as following:

Definitions

```
\newcommand{\Identityb}         {\renewcommand{\arraystretch}{1.5}
                                 \left[
                                  \begin{array}{c c}
                                   1~ & ~0 \\
                                   0~ & ~1
                                  \end{array}
                                 \right]}
```

```
\newcommand{\Identityc}         {\renewcommand{\arraystretch}{1.5}
                                 \left[
                                  \begin{array}{c c c}
                                   ~1~ & 0~ & 0~ \\
                                   ~0~ & 1~ & 0~ \\
                                   ~0~ & 0~ & 1~
                                  \end{array}
                                 \right]}
```

```
\newcommand{\Identityd}         {\renewcommand{\arraystretch}{1.5}
                                 \left[
                                  \begin{array}{c c c c}
                                   ~1~ & 0~ & 0~ & 0~ \\
                                   ~0~ & 1~ & 0~ & 0~ \\
                                   ~0~ & 0~ & 1~ & 0~ \\
                                   ~0~ & 0~ & 0~ & 1~
                                  \end{array}
                                 \right]}
```

where I used the letter "b", "c", or "d" to indicate "2", "3", or "4", because we can not define `\newcommand`s involving numbers... On the other hand, sometimes we need a matrix with vectors or smaller identity matrices as elements. Hence, I defined these identity matrices:

$$\begin{bmatrix} \mathbf{1} & 0 \\ 0 & \mathbf{1} \end{bmatrix}$$ `\IdentityB`

$$\begin{bmatrix} \mathbf{1} & 0 & 0 \\ 0 & \mathbf{1} & 0 \\ 0 & 0 & \mathbf{1} \end{bmatrix}$$ `\IdentityC`

Definitions

```
\newcommand{\IdentityB}         {\renewcommand{\arraystretch}{1.5}
                                 \left[
                                  \begin{array}{c c}
                                   {\bf 1}~ &      0 \\
                                        0 ~ & {\bf 1}
                                  \end{array}
                                 \right]}
```

```
\newcommand{\IdentityC}         {\renewcommand{\arraystretch}{1.5}
                                 \left[
                                  \begin{array}{c c c}
                                   {\bf 1}~ &      0 ~ &      0  \\
                                        0 ~ & {\bf 1}~ &      0  \\
                                        0 ~ &      0 ~ & {\bf 1}
                                  \end{array}
                                 \right]}
```

Note here that I *didn't* define an `\IdentityD` matrix.

3.2 Pauli matrices

The three Pauli matrices:

$$\sigma_x = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$$ \Paulix

$$\sigma_y = \begin{bmatrix} 0 & -i \\ i & 0 \end{bmatrix}$$ \Pauliy

$$\sigma_z = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$$ \Pauliz

have also been defined:

Definitions

```
\newcommand{\Paulix}          {\renewcommand{\arraystretch}{1.5}
                               \left[
                                \begin{array}{c c}
                                 0~ & ~1 \\
                                 1~ & ~0
                                \end{array}
                               \right]}
```

```
\newcommand{\Pauliy}          {\renewcommand{\arraystretch}{1.5}
                               \left[
                                \begin{array}{c c}
                                 0 & -i \\
                                 i &  0
                                \end{array}
                               \right]}
```

```
\newcommand{\Pauliz}          {\renewcommand{\arraystretch}{1.5}
                               \left[
                                \begin{array}{c c}
                                 1 &  0 \\
                                 0 & -1
                                \end{array}
                               \right]}
```

Note that I use `\Paulix`, `\Pauliy`, and `\Pauliz` for these three "Pauli" matrices, although the physicists use usually σ_x, σ_y, and σ_z to denote them.

3.3 Dirac γ matrices

The system of the Dirac γ matrices is a little complicate. First, the γ^1 to γ^3:

$$\gamma^1 = \begin{bmatrix} 0 & \sigma_x \\ -\sigma_x & 0 \end{bmatrix} \qquad \texttt{\textbackslash gammaa}$$

$$\gamma^2 = \begin{bmatrix} 0 & \sigma_y \\ -\sigma_y & 0 \end{bmatrix} \qquad \texttt{\textbackslash gammab}$$

$$\gamma^3 = \begin{bmatrix} 0 & \sigma_z \\ -\sigma_z & 0 \end{bmatrix} \qquad \texttt{\textbackslash gammac}$$

have been defined as

Definitions

```
\newcommand{\gammaa}          {\renewcommand{\arraystretch}{1.5}
                               \left[
                                \begin{array}{c c}
                                  0        & \sigma_x \\
                                 -\sigma_x & 0
                                \end{array}
                               \right]}
```

```
\newcommand{\gammab}          {\renewcommand{\arraystretch}{1.5}
                               \left[
                                \begin{array}{c c}
                                  0        & \sigma_y \\
                                 -\sigma_y & 0
                                \end{array}
                               \right]}
```

```
\newcommand{\gammac}          {\renewcommand{\arraystretch}{1.5}
                               \left[
                                \begin{array}{c c}
                                  0        & \sigma_z \\
                                 -\sigma_z & 0
                                \end{array}
                               \right]}
```

where I used, as usual, "a", "b", and "c" to indicate "1", "2", and "3". Note that I used here `\gammaa`, `\gammab`, and so on for these Dirac "gamma" matrices (not `\Diraca`, `\Diracb`, etc...). Moreover, for a general case, I have these two choices:

$$\gamma^i = \left[\begin{array}{cc} 0 & \sigma^i \\ -\sigma^i & 0 \end{array} \right]$$ \gammai

$$\gamma^\mu = \left[\begin{array}{cc} 0 & \sigma^\mu \\ -\sigma^\mu & 0 \end{array} \right]$$ \gammax{\mu}

Note here that the command \gammai is fixed as above. This means that, if you need a matrix such as

$$\left[\begin{array}{cc} 0 & \sigma^j \\ -\sigma^j & 0 \end{array} \right]$$

or

$$\left[\begin{array}{cc} 0 & \sigma^a \\ -\sigma^a & 0 \end{array} \right]$$

you have to use the command \gammax{j} or \gammax{a}.

Definitions

```
\newcommand{\gammai}            {\renewcommand{\arraystretch}{1.5}
                                 \left[
                                  \begin{array}{c c}
                                     0       & \sigma^i \\
                                   -\sigma^i &  0
                                  \end{array}
                                 \right]}
```

```
\newcommand{\gammax}       [1]  {\renewcommand{\arraystretch}{1.5}
                                 \left[
                                  \begin{array}{c c}
                                     0          & \sigma^{#1} \\
                                   -\sigma^{#1} &  0
                                  \end{array}
                                 \right]}
```

Certainly, it is useful to define \newcommands for matrices involving the momentum or the 4-momentum:

$$\left[\begin{array}{cc} 0 & \boldsymbol{\sigma} \\ -\boldsymbol{\sigma} & 0 \end{array} \right]$$ \gammaV

$$\left[\begin{array}{cc} 0 & \boldsymbol{\sigma}\cdot\mathbf{p} \\ -\boldsymbol{\sigma}\cdot\mathbf{p} & 0 \end{array} \right]$$ \gammaVx{p}

$$\left[\begin{array}{cc} E_p & -\boldsymbol{\sigma}\cdot\mathbf{p} \\ \boldsymbol{\sigma}\cdot\mathbf{p} & -E_p \end{array} \right]$$ \gammaVX{E_p}{p}

Definitions

```
\newcommand{\gammaV}            {\renewcommand{\arraystretch}{1.5}
                                 \left[
                                  \begin{array}{c c}
                                    0           & \bfG{\sigma} \\
                                   -\bfG{\sigma} &  0
                                  \end{array}
                                 \right]}
```

```
\newcommand{\gammaVx}      [1]  {\renewcommand{\arraystretch}{1.5}
                                 \left[
                                  \begin{array}{c c}
                                    0                       & \bfG{\sigma}\cdot{\bf #1} \\
                                   -\bfG{\sigma}\cdot\bf {#1} &  0
                                  \end{array}
                                 \right]}
```

```
\newcommand{\gammaVX}      [2]  {\renewcommand{\arraystretch}{1.5}
                                 \left[
                                  \begin{array}{c c}
                                    #1                      & -\bfG{\sigma}\cdot{\bf #2} \\
                                   \bfG{\sigma}\cdot\bf {#2} & -#1
                                  \end{array}
                                 \right]}
```

On the other hand, there are two different definitions for γ^0 and therefore also two for γ^5:

$$\gamma^0 = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix} \qquad \texttt{\gammaz}$$

$$\gamma^0 = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix} \qquad \texttt{\gammaZ}$$

$$\gamma^5 = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} \qquad \texttt{\gammae}$$

$$\gamma^5 = \begin{bmatrix} -1 & 0 \\ 0 & 1 \end{bmatrix} \qquad \texttt{\gammaE}$$

where the "z" and "Z" stand for "zero", and the "e" and "E" indicate "5".

Definitions

```
\newcommand{\gammaz}          {\renewcommand{\arraystretch}{1.5}
                               \left[
                                \begin{array}{c c}
                                 1 &  0 \\
                                 0 & -1
                                \end{array}
                               \right]}
```

```
\newcommand{\gammaZ}          {\renewcommand{\arraystretch}{1.5}
                               \left[
                                \begin{array}{c c}
                                  0 & 1 \\
                                 -1 & 0
                                \end{array}
                               \right]}
```

```
\newcommand{\gammae}          {\renewcommand{\arraystretch}{1.5}
                               \left[
                                \begin{array}{c c}
                                 0~ & ~1 \\
                                 1~ & ~0
                                \end{array}
                               \right]}
```

```
\newcommand{\gammaE}          {\renewcommand{\arraystretch}{1.5}
                               \left[
                                \begin{array}{c c}
                                 -1 & 0 \\
                                  0 & 1
                                \end{array}
                               \right]}
```

3.4 Gell-Mann λ matrices

The eight Gell-Mann λ matrices:

$$\lambda^1 = \begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} \qquad \texttt{\lambdaa}$$

$$\lambda^2 = \begin{bmatrix} 0 & -i & 0 \\ i & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} \qquad \texttt{\lambdab}$$

$$\lambda^3 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 0 \end{bmatrix} \qquad \texttt{\lambdac}$$

$$\lambda^4 = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 0 & 0 \\ 1 & 0 & 0 \end{bmatrix} \qquad \texttt{\lambdad}$$

$$\lambda^5 = \begin{bmatrix} 0 & 0 & -i \\ 0 & 0 & 0 \\ i & 0 & 0 \end{bmatrix} \qquad \texttt{\lambdae}$$

$$\lambda^6 = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix} \qquad \texttt{\lambdaf}$$

$$\lambda^7 = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & -i \\ 0 & i & 0 \end{bmatrix} \qquad \texttt{\lambdag}$$

$$\lambda^8 = \frac{1}{\sqrt{3}} \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & -2 \end{bmatrix} \qquad \texttt{\lambdah}$$

have also been defined with the commands `\lambdaa`, `\lambdab`, ..., `\lambdah`.

Definitions

```
\newcommand{\lambdaa}          {\renewcommand{\arraystretch}{1.5}
                                \left[
                                 \begin{array}{c c c}
                                  ~0~ & 1~ & 0~ \\
                                  ~1~ & 0~ & 0~ \\
                                  ~0~ & 0~ & 0~
                                 \end{array}
                                \right]}
```

```
\newcommand{\lambdab}          {\renewcommand{\arraystretch}{1.5}
                                \left[
                                 \begin{array}{c c c}
                                  ~0  & -i & 0~ \\
                                  ~i  &  0 & 0~ \\
                                  ~0  &  0 & 0~
                                 \end{array}
                                \right]}
```

```
\newcommand{\lambdac}          {\renewcommand{\arraystretch}{1.5}
                                \left[
                                 \begin{array}{c c c}
                                  ~1  &  0 & 0~ \\
                                  ~0  & -1 & 0~ \\
                                  ~0  &  0 & 0~
                                 \end{array}
                                \right]}
```

```
\newcommand{\lambdad}          {\renewcommand{\arraystretch}{1.5}
                                \left[
                                 \begin{array}{c c c}
                                  ~0~ & 0~ & 1~ \\
                                  ~0~ & 0~ & 0~ \\
                                  ~1~ & 0~ & 0~
                                 \end{array}
                                \right]}
```

```
\newcommand{\lambdae}          {\renewcommand{\arraystretch}{1.5}
                                \left[
                                 \begin{array}{c c c}
                                  ~0~ & 0 & -i \\
                                  ~0~ & 0 &  0 \\
                                  ~i~ & 0 &  0
                                 \end{array}
                                \right]}
```

```
\newcommand{\lambdaf}          {\renewcommand{\arraystretch}{1.5}
                                \left[
                                 \begin{array}{c c c}
                                  ~0~ & 0~ & 0~ \\
                                  ~0~ & 0~ & 1~ \\
                                  ~0~ & 1~ & 0~
                                 \end{array}
                                \right]}
```

```
\newcommand{\lambdag}          {\renewcommand{\arraystretch}{1.5}
                                \left[
                                 \begin{array}{c c c}
                                  ~0~ & 0 &  0 \\
                                  ~0~ & 0 & -i \\
                                  ~0~ & i &  0
                                 \end{array}
                                \right]}
```

```
\newcommand{\lambdah}          {\frac{1}{\sqrt{3}}
                                \renewcommand{\arraystretch}{1.5}
                                \left[
                                 \begin{array}{c c c}
                                  ~1~ & 0 &  0 \\
                                  ~0~ & 1 &  0 \\
                                  ~0~ & 0 & -2
                                 \end{array}
                                \right]}
```

Here I used "a", "b", ..., "h" to indicate "1", "2", ..., "8".

4 Tables

All of the `\newcommand`s introduced in this section *have not been defined* in my `CLShanCommands-Math.tex` file. Because there could be many (actually too many) variations of the commands with tiny differences. Hence, I personally prefer to define some of them in the preamble of a new created file when I really need them, and perhaps trwrite the definitions more suitable.

4.1 `\multicolumn` command

Definitions

```
\newcommand{\bc}          [1]  {\multicolumn{2}{| c |}{#1}}

\newcommand{\bcl}         [1]  {\multicolumn{2}{| c  }{#1}}

\newcommand{\bcr}         [1]  {\multicolumn{2}{  c |}{#1}}
```

```
\newcommand{\bl}          [1]  {\multicolumn{2}{| l |}{#1}}
\newcommand{\bll}         [1]  {\multicolumn{2}{| l  }{#1}}
\newcommand{\blr}         [1]  {\multicolumn{2}{  l |}{#1}}
```

```
\newcommand{\br}          [1]  {\multicolumn{2}{| r |}{#1}}
\newcommand{\brl}         [1]  {\multicolumn{2}{| r  }{#1}}
\newcommand{\brr}         [1]  {\multicolumn{2}{  r |}{#1}}
```

The first letter in the commands above, "b", denotes that we want to combine "two" columns (`\multicolumn{2}`), the second letter "c", "l", or "r" describes the position of the element ("center", "left" or "right"), the third letter "l" or "r" indicates that there is "only one" vertical line on the "left" or "right" side of this element. If there are two lines on the both side of the element, then we treat this choice as default and write nothing. According to this method, we can build lots of the other `\newcommand`s, for example,

Definitions

```
\newcommand{\ac}          [1]  {\multicolumn{1}{| c |}{#1}}
\newcommand{\acl}         [1]  {\multicolumn{1}{| c  }{#1}}
\newcommand{\acr}         [1]  {\multicolumn{1}{  c |}{#1}}
```

```
\newcommand{\cc}          [1]  {\multicolumn{3}{| c |}{#1}}
\newcommand{\ccl}         [1]  {\multicolumn{3}{| c  }{#1}}
\newcommand{\ccr}         [1]  {\multicolumn{3}{  c |}{#1}}
```

or, even two lines on each side of the element:

Definitions

```
\newcommand{\dc}          [1]  {\multicolumn{4}{|| c ||}{#1}}
\newcommand{\dcl}         [1]  {\multicolumn{4}{|| c   }{#1}}
\newcommand{\dcr}         [1]  {\multicolumn{4}{   c ||}{#1}}
```

```
\newcommand{\ec}          [1]  {\multicolumn{5}{|  c  |}{#1}}
\newcommand{\ecl}         [1]  {\multicolumn{5}{|| c   }{#1}}
\newcommand{\ecr}         [1]  {\multicolumn{5}{   c ||}{#1}}
```

On the other hand, sometimes we want not only to combine more columns but also to use the same element. For such cases, we can simply extend the above system to the following one with a "T" (stands for "text):

Definitions

```
\newcommand{\bcT}               {\multicolumn{2}{| c |}{.....}}
\newcommand{\bclT}              {\multicolumn{2}{| c  }{.....}}
\newcommand{\bcrT}              {\multicolumn{2}{  c |}{.....}}
```

```
\newcommand{\blT}               {\multicolumn{2}{| l |}{.....}}
\newcommand{\bllT}              {\multicolumn{2}{| l  }{.....}}
\newcommand{\blrT}              {\multicolumn{2}{  l |}{.....}}
```

```
\newcommand{\brT}               {\multicolumn{2}{| r |}{.....}}
\newcommand{\brlT}              {\multicolumn{2}{| r  }{.....}}
\newcommand{\brrT}              {\multicolumn{2}{  r |}{.....}}
```

where the "....." denotes the fixed text which need to be used more times.

4.2 `\makebox` command

Definitions

```
\newcommand{\mbxc}          [2]  {\makebox[#1 cm][c]{#2}}
\newcommand{\mbxl}          [2]  {\makebox[#1 cm][l]{#2}}
\newcommand{\mbxr}          [2]  {\makebox[#1 cm][r]{#2}}
```

Here I used "mbx" as an abbreviation for "makebox" and also "c", "l", and "r" to indicate the position of the element. Moreover, similar to what I did with the `\multicolumn` command, we can define `\newcommand`s with a fixed element or with a fixed width of the box:

Definitions

```
\newcommand{\mbxcT}         [1]  {\makebox[#1 cm][c]{.....}}
\newcommand{\mbxlT}         [1]  {\makebox[#1 cm][l]{.....}}
\newcommand{\mbxrT}         [1]  {\makebox[#1 cm][r]{.....}}
```

```
\newcommand{\mbxcW}         [1]  {\makebox[...cm][c]{#1}}
\newcommand{\mbxlW}         [1]  {\makebox[...cm][l]{#1}}
\newcommand{\mbxrW}         [1]  {\makebox[...cm][r]{#1}}
```

or, even both of them:

Definitions

```
\newcommand{\mbxcWT}            {\makebox[...cm][c]{......}}

\newcommand{\mbxlWT}            {\makebox[...cm][l]{......}}

\newcommand{\mbxrWT}            {\makebox[...cm][r]{......}}
```

where the "W" stands for the fixed "width" of the box.

5 Beamer Class

I defined some `\newcommand`s specially for the `beamer` class (the `CLShanCommands-Beamer.tex` file and the `clshan-beamer.sty` package). Please note here, you "must" use the `CLShanCommands-Math.tex` file or the `clshan-math.sty` package at first and then the `CLShanCommands-Beamer.tex` file or the `clshan-beamer.sty` package!

5.1 `equation` and `eqnarray` environments

For a presentation, we usually show equations without equation numbers. This means that we only need the `\[ \]` and the `eqnarray*` environments. Meanwhile, equations in the `\normalsize` are for me too large to use (on one slide I can give too less equations and information as I hope). Hence, I defined now and just for the `beamer` class the `\newcommand`s which I suggested you in section 1.3, the `\eqin` and the `\eqnin` with the `\footnotesize`:

Definitions

```
\newcommand{\eqin}          [1]  {{\footnotesize \[                #1 \]              }}

\newcommand{\eqnin}         [1]  {{\footnotesize \begin{eqnarray*} #1 \end{eqnarray*}}}
```

Note that I used here the `\eqin` for the "`\[ \]`" (not the `equation`) environment and the `\eqnin` for the "`eqnarray*`" (not the `eqnarray`) environment. Because I don't want to use the `equation` and the `eqnarray` environments for my presentations. Moreover, I also defined `\newcommand`s with the `\scriptsize` and the `\tiny`:

Definitions

```
\newcommand{\eqsin}         [1]  {{\scriptsize   \[                #1 \]              }}

\newcommand{\eqnsin}        [1]  {{\scriptsize   \begin{eqnarray*} #1 \end{eqnarray*}}}
```

```
\newcommand{\eqxin}         [1]  {{\tiny         \[                #1 \]              }}

\newcommand{\eqnxin}        [1]  {{\tiny         \begin{eqnarray*} #1 \end{eqnarray*}}}
```

Here I used the letter "s" and "x" to indicate "smaller" and "extreme small" (not the `\small`, but just compare with the `\footnotesize`). Furthermore, it seems to be better to define `\newcommand`s for the cases in which I need to *enlarge* the size of my equations, although they would be used very very seldom.

Definitions

```
\newcommand{\eqlin}         [1]  {{\small        \[                #1 \]              }}

\newcommand{\eqnlin}        [1]  {{\small        \begin{eqnarray*} #1 \end{eqnarray*}}}
```

where I used "l" to indicate "larger" (not the `\large`, but just compare with the `\footnotesize`). On the other hand, because I set the `\footnotesize` as the usual size for my equations on the slides, I need to correct (redefine) the space on the both side of an "=" sign in the `eqnarray*` environment (This is why you must use the `CLShanCommands-Math.tex` file or the `clshan-math.sty` package at first and then the `CLShanCommands-Beamer.tex` file or the `clshan-beamer.sty` package.):

Definitions

```
\renewcommand{\&}              {&\hspace{-2.25ex}}

\renewcommand{\=}              {&\hspace{-2.25ex} = &\hspace{-2.25ex}}
```

Note that I don't know why I need to correct this. So if you set one another size as your usual size for the equations on the slides, "perhaps" you have to correct my "correction". Finally, when I putted an equation directly under a title such like

- Rate equation of the WIMP-nucleus elastic scattering:

$$\frac{dR}{dQ} = \mathcal{A}F^2(Q) \int_{v_{\min}}^{\infty} \left[\frac{f_1(v)}{v} \right] dv$$

Because the height of this equation is higher than that of a normal text, this equation will push the title upwards. This means that this title will be higher than the other one on the previous or the next slide. When I go through these pages, the bullet will be seen a small shift first upwards and then downwards. I don't like this shift. My solution for this shift-problem is: insert one line with just one space `~` between the title and the equation, then shift this equation upwards. For this solution I defined the following `\newcommand`:

Definitions

```
\newcommand{\eqdown}       [1]  {\\ ~ \vspace{#1cm}}
```

Note that you have to give a "minus" distance as the parameter for this command to pull the equation "upwards", although I used the word "down". Because the total effect of the command is to push the equation "downwards" in order to let the title not be pushed upwards.

Example

```
\eqdown{-0.3}
```

5.2 Redefining the `\newcommands` for the `eqnarray` environment in Section 1.3

Like what I did for the `\&` and the `\=` commands in Section 5.1, I have to readjust the width of the space on both sides of each binary relation defined in Section 1.3 for using the `beamer` class, so that you can copy the formulae directly from your papers or notes and paste them in the `beamer` files without changing anything. But, let me remind you again, you must use the `CLShanCommands-Math.tex` file or the `clshan-math.sty` package at first and then the `CLShanCommands-Beamer.tex` file or the `clshan-beamer.sty` package!

Definitions

```
\renewcommand{\eqnneq}         {& \hspace{-2.25ex} \neq    & \hspace{-2.25ex}}

\renewcommand{\eqnne}          {& \hspace{-2.25ex} \ne     & \hspace{-2.25ex}}
```

```
\renewcommand{\eqnleq}          {& \hspace{-2.25ex} \leq    & \hspace{-2.25ex}}
\renewcommand{\eqnle}           {& \hspace{-2.25ex} \le     & \hspace{-2.25ex}}
```

```
\renewcommand{\eqngeq}          {& \hspace{-2.25ex} \geq    & \hspace{-2.25ex}}
\renewcommand{\eqnge}           {& \hspace{-2.25ex} \ge     & \hspace{-2.25ex}}
```

```
\renewcommand{\eqnll}           {& \hspace{-2.25ex} \ll     & \hspace{-2.25ex}}
\renewcommand{\eqngg}           {& \hspace{-2.25ex} \gg     & \hspace{-2.25ex}}
```

```
\renewcommand{\eqnequiv}        {& \hspace{-2.25ex} \equiv  & \hspace{-2.25ex}}
\renewcommand{\eqndoteq}        {& \hspace{-2.25ex} \doteq  & \hspace{-2.25ex}}
```

```
\renewcommand{\eqncong}         {& \hspace{-2.25ex} \cong   & \hspace{-2.25ex}}
\renewcommand{\eqnapprox}       {& \hspace{-2.25ex} \approx & \hspace{-2.25ex}}
```

```
\renewcommand{\eqnsimeq}        {& \hspace{-2.25ex} \simeq  & \hspace{-2.25ex}}
\renewcommand{\eqnsim}          {& \hspace{-2.25ex} \sim    & \hspace{-2.25ex}}
```

```
\renewcommand{\eqnpropto}       {& \hspace{-2.25ex} \propto & \hspace{-2.25ex}}
```

```
\renewcommand{\conti}           {& \hspace{-2.25ex} ~       & \hspace{-2.25ex}}
```

```
\renewcommand{\eqnBinary}  [1]  {& \hspace{-2.25ex} #1      & \hspace{-2.25ex}}
```

5.3 Colors

For the people so lazy like me, it seems to be a nice idea to define some `\newcommand`s which can reduce (although maybe not too much) the length of the commands.

Definitions

```
\newcommand{\red}          [1]  {{\color{red}  {#1}}}
\newcommand{\green}        [1]  {{\color{green}{#1}}}
\newcommand{\blue}         [1]  {{\color{blue} {#1}}}
```

Note here that, these commands require a parameter. This means that you must put the text which you want to change the color in a curly parentheses `{ }`. If you forget to indicate that the whole text must be treated as one element, then there is only one (the first) letter will be changed its color.

Examples

red	`\red{red}`
red	`{\red red}`

5.4 `column` environment

I have to use the `columnsonlytextwidth` environment to put two or three pictures on the same row for my talks. It seems to be convenient to define some `\newcommand`s for the `column` environment with `center`, `flushleft`, or `flushright` environment first.

Definitions

```
\newcommand{\columncenter}      [2]  {\begin{column}{#1 cm}
                                       \begin{center}
                                        #2
                                       \end{center}
                                       \end{column}}
```

```
\newcommand{\columnleft}        [2]  {\begin{column}{#1 cm}
                                       \begin{flushleft}
                                        #2
                                       \end{flushleft}
                                       \end{column}}
```

```
\newcommand{\columnright}       [2]  {\begin{column}{#1 cm}
                                       \begin{flushright}
                                        #2
                                       \end{flushright}
                                       \end{column}}
```

In the next sections you will find some examples of these three commands. I will use them directly in order to reduce my definitions of the other `\newcommand`s. Usually, I defined the `\newcommand`s with only the original LaTeX commands, then I'm sure that I (and anybody else) can just copy some of them to the preamble of a new document without including the whole `CLShanCommands-Math.tex`. But for the commands defined in the next sections, it is in fact better to use some of my defined commands directly.

5.5 Frames for inserting pictures

There are two reasons to let me use a frame instead of a picture when I prepare my talk. First, my notebook is six one-half years old and seems to be tired to work with pictures. Second, sometimes I know I will give a picture at this place but in this moment I don't have this picture. Hence, It is useful to define some `\newcommand`s to simply draw some frames to reserve the places in which I will put pictures.

Definition

```
\newcommand{\picframe}          [3]  {\begin{picture}(#1,#2)
                                       \put( 0, 0){\line(1,0){#1}}
                                       \put( 0, 0){\line(0,1){#2}}
                                       \put( 0,#2){\line(1,0){#1}}
                                       \put(#1, 0){\line(0,1){#2}}
                                       \put( 0, 0){\makebox(#1,#2){#3}}
                                       \end{picture}}
```

Note here that, first, I will also use this `\picframe` as a basic command later; second, for each `\newcommand` defined in the rest of this section, I will always give you a list of its parameters and an example to let you know how to use these commands without understanding their definitions.

Parameters

#1: width of this frame

#2: height of this frame

#3: a name to remain you which picture should be here

Note that I *didn't* define this command in the `center` environment, because I have to reserve this degree of freedom to combine this command with the `flushleft` or the `flushright` environment. (You can find the advantage of the reservation of this degree of freedom later.) So with this command you can just get a frame in perhaps left side of one slide. If you want to put this frame in the center of the text, you need to `\begin` the `center` environment.

Example

```
\begin{center}
\picframe{4}{3}{dRdQ}
\end{center}
```

If you want to put two pictures in one row, you must consider about whether these two pictures have the same width. If two frames have (more or less) the same width, you can use this `\newcommand`:

Definition

```
\newcommand{\picdframe}         [6]  {\vspace{0.3cm}
                                       \begin{columnsonlytextwidth}
                                       \columnright {#2}{\picframe{#3}{#4}{#5}}
                                       \columncenter{#1}{~}
                                       \hspace{-0.6cm}
                                       \columnleft  {#2}{\picframe{#3}{#4}{#6}}
                                       \end{columnsonlytextwidth}
                                       \vspace{0.1cm}}
```

Here the parameters have been defined as

Parameters

#1: space width between these two frames
#2: common column width
#3: common width of the two frames
#4: common height of the two frames
#5: name of the left frame
#6: name of the right frame
#1 + #2 × 2 = text width (default: 10.8 cm)

Note here that the sum of the widths of the two columns and the space between them (i.e., #1 + #2 × 2) *must be* equal to the *width of the text*. (The default of the text width is 10.8 cm.) For the case in which two frames have different widths, I defined a `\newcommand` with 9 parameters (*sorry!*):

Definition

```
\newcommand{\picDframe}         [9]  {\vspace{0.3cm}
                                      \begin{columnsonlytextwidth}
                                      \columnright {#2}{\picframe{#4}{#5}{#6}}
                                      \columncenter{#1}{~}
                                      \hspace{-0.6cm}
                                      \columnleft  {#3}{\picframe{#7}{#8}{#9}}
                                      \end{columnsonlytextwidth}
                                      \vspace{0.1cm}}
```

Here the parameters have been defined as

Parameters

#1: space width between these two frames
#2: width of the left column
#3: width of the right column
#4: width of the left frame
#5: height of the left frame
#6: name of the left frame
#7: width of the right frame
#8: height of the right frame
#9: name of the right frame
#1 + #2 + #3 = text width (default: 10.8 cm)

Here the small "d" and capital "D" denote "double" and I will always use a small letter for columns with equal width and a capital letter for columns with different width.

Examples

```
\picdframe{0.8}{5}    {4.5}{3}{DAMA-4yrs}           {DAMA-7yrs}

\picDframe{0.8}{6}{4} {5.5}{3}{DAMA-4yrs} {3.5}{2.5}{DAMA-7yrs}
```

I also defined a command for the case of three frames which have the same width:

Definition

```
\newcommand{\pictframe}         [7]  {\vspace{0.3cm}
                                      \begin{columnsonlytextwidth}
                                      \columnright {#2}{\picframe{#3}{#4}{#5}}
                                      \columncenter{#1}{~}
                                      \hspace{-0.6cm}
                                      \columncenter{#2}{\picframe{#3}{#4}{#6}}
                                      \columncenter{#1}{~}
                                      \hspace{-0.6cm}
                                      \columnleft  {#2}{\picframe{#3}{#4}{#7}}
                                      \end{columnsonlytextwidth}
                                      \vspace{0.1cm}}
```

Parameters

#1: space width between two neighbor frames
#2: common column width
#3: common width of the three frames
#4: common height of the three frames
#5: name of the left frame
#6: name of the middle frame
#7: name of the right frame
$\#1 \times 2 + \#2 \times 3$ = text width (default: 10.8 cm)

For the case of three frames which have different widths, I have

Definition

```
\newcommand{\picTframe}         [7]  {\vspace{0.3cm}
                                      \begin{columnsonlytextwidth}
                                      \columnright {#2}{\picframe #5}
                                      \columncenter{#1}{~}
                                      \hspace{-0.6cm}
                                      \columncenter{#3}{\picframe #6}
                                      \columncenter{#1}{~}
                                      \hspace{-0.6cm}
                                      \columnleft  {#4}{\picframe #7}
                                      \end{columnsonlytextwidth}
                                      \vspace{0.1cm}}
```

Parameters

#1: space width between two neighbor frames
#2: width of the left column
#3: width of the middle column
#4: width of the right column
#5: width, height, and name of the left frame
#6: width, height, and name of the middle frame
#7: width, height, and name of the right frame
#1 × 2 + #2 + #3 + #4 = text width (default: 10.8 cm)
#5, #6, #7: {width} {height} {name}

Here the small "t" and capital "T" denote "triple" and the small and the capital letter are for columns with equal or different width, respectively. Note that because the number of parameters for one `\newcommand` can be maximum 9, the last three parameters must be written as such form: {width}{height}{name}.

Examples

```
\pictframe{0.6}{3.2}        {3}{3}{Coma}         {Hydra}           {Perseus}

\picTframe{0.3}{3}{3}{4.2} {{3}{3}{Coma}} {{3}{3}{Hydra}} {{3.8}{3}{Perseus}}
```

5.6 Inserting pictures with the \pgfuseimage command

First, I gave an other name for the command `\pgfuseimage` in order to let the commands for this system easily to remember.

Definition

```
\newcommand{\imagein}          [1]  {\pgfuseimage{#1}}
```

Example

```
\imagein{dRdQ}
```

Now, similar to what I did in the last section, I considered the cases of two or three images which have the same or different widths, respectively. Actually, what I had to do is just change the command `\picframe` to `\pgfuseimage`. Two images with the same width:

Definition

```
\newcommand{\imagedin}         [4]  {\vspace{0.3cm}
                                     \begin{columnsonlytextwidth}
                                     \columnright {#2}{\pgfuseimage{#3}}
                                     \columncenter{#1}{~}
                                     \hspace{-0.6cm}
                                     \columnleft  {#2}{\pgfuseimage{#4}}
                                     \end{columnsonlytextwidth}
                                     \vspace{0.1cm}}
```

Parameters

#1: space width between two images
#2: common column width
#3: name of the left image
#4: name of the right image
#1 + #2 × 2 = text width (default: 10.8 cm)

Two images have different widths:

Definition

```
\newcommand{\imageDin}          [5]  {\vspace{0.3cm}
                                      \begin{columnsonlytextwidth}
                                      \columnright {#2}{\pgfuseimage{#4}}
                                      \columncenter{#1}{~}
                                      \hspace{-0.6cm}
                                      \columnleft  {#3}{\pgfuseimage{#5}}
                                      \end{columnsonlytextwidth}
                                      \vspace{0.1cm}}
```

Parameters

#1: space width between two images
#2: width of the left column
#3: width of the right column
#4: name of the left image
#5: name of the right image
#1 + #2 + #3 = text width (default: 10.8 cm)

Examples

```
\imagedin{0.8}{5}    {DAMA-4yrs} {DAMA-7yrs}

\imageDin{0.8}{6}{4} {DAMA-4yrs} {DAMA-7yrs}
```

Three images have the same width:

Definition

```
\newcommand{\imagetin}          [5]  {\vspace{0.3cm}
                                      \begin{columnsonlytextwidth}
                                      \columnright {#2}{\pgfuseimage{#3}}
                                      \columncenter{#1}{~}
                                      \hspace{-0.6cm}
                                      \columncenter{#2}{\pgfuseimage{#4}}
                                      \columncenter{#1}{~}
                                      \hspace{-0.6cm}
                                      \columnleft  {#2}{\pgfuseimage{#5}}
                                      \end{columnsonlytextwidth}
                                      \vspace{0.1cm}}
```

Parameters

#1: space width between two neighbor images
#2: common column width
#3: name of the left image
#4: name of the middle image
#5: name of the right image
#1 × 2 + #2 × 3 = text width (default: 10.8 cm)

Three images have different widths:

Definition

```
\newcommand{\imageTin}          [7]  {\vspace{0.3cm}
                                      \begin{columnsonlytextwidth}
                                      \columnright {#2}{\pgfuseimage{#5}}
                                      \columncenter{#1}{~}
                                      \hspace{-0.6cm}
                                      \columncenter{#3}{\pgfuseimage{#6}}
                                      \columncenter{#1}{~}
                                      \hspace{-0.6cm}
                                      \columnleft  {#4}{\pgfuseimage{#7}}
                                      \end{columnsonlytextwidth}
                                      \vspace{0.1cm}}
```

Parameters

#1: space width between two neighbor images
#2: width of the left column
#3: width of the middle column
#4: width of the right column
#5: name of the left image
#6: name of the middle image
#7: name of the right image
#1 × 2 + #2 + #3 + #4 = text width (default: 10.8 cm)

Examples

```
\imagetin{0.6}{3.2}       {Coma} {Hydra} {Perseus}

\imageTin{0.3}{3}{3}{4.2} {Coma} {Hydra} {Perseus}
```

5.7 Inserting pictures with the \includegraphics command

In order to complete my whole system of inserting pictures on a slide, I defined also \newcommands using the \includegraphics command. Actually, I just changed the command \pgfuseimage to \includegraphics. The whole structure of the two-columns and three-columns (in fact three and five) systems are perfect, right?

Definition

```
\newcommand{\epsin}            [2]  {\includegraphics[scale=#1]{#2.eps}}
```

Example

```
\epsin{0.25}{dRdQ}
```

Two eps-images have the same width:

Definition

```
\newcommand{\epsdin}           [5]  {\vspace{0.3cm}
                                     \begin{columnsonlytextwidth}
                                     \columnright {#2}{\includegraphics[scale=#3]{#4.eps}}
                                     \columncenter{#1}{~}
                                     \hspace{-0.6cm}
                                     \columnleft  {#2}{\includegraphics[scale=#3]{#5.eps}}
                                     \end{columnsonlytextwidth}
                                     \vspace{0.1cm}}
```

Parameters

#1: space width between two eps-images
#2: common column width
#3: common scale for these two eps-images
#4: name of the left eps-image
#5: name of the right eps-image
#1 + #2 × 2 = text width (default: 10.8 cm)

Two eps-images have different widths:

Definition

```
\newcommand{\epsDin}            [7]  {\vspace{0.3cm}
                                      \begin{columnsonlytextwidth}
                                      \columnright {#2}{\includegraphics[scale=#4]{#5.eps}}
                                      \columncenter{#1}{~}
                                      \hspace{-0.6cm}
                                      \columnleft  {#3}{\includegraphics[scale=#6]{#7.eps}}
                                      \end{columnsonlytextwidth}
                                      \vspace{0.1cm}}
```

Parameters

#1: space width between two eps-images
#2: width of the left column
#3: width of the right column
#4: scale for the left eps-image
#5: name of the left eps-image
#6: scale for the right eps-image
#7: name of the right eps-image
#1 + #2 + #3 = text width (default: 10.8 cm)

Examples

```
\espdin{0.8}{5}    {0.3}{DAMA-4yrs}       {DAMA-7yrs}

\epsDin{0.8}{6}{4} {0.3}{DAMA-4yrs} {0.35}{DAMA-7yrs}
```

Three eps-images have the same width:

Definition

```
\newcommand{\epstin}            [6]  {\vspace{0.3cm}
                                      \begin{columnsonlytextwidth}
                                      \columnright {#2}{\includegraphics[scale=#3]{#4.eps}}
                                      \columncenter{#1}{~}
                                      \hspace{-0.6cm}
                                      \columncenter{#2}{\includegraphics[scale=#3]{#5.eps}}
                                      \columncenter{#1}{~}
                                      \hspace{-0.6cm}
                                      \columnleft  {#2}{\includegraphics[scale=#3]{#6.eps}}
                                      \end{columnsonlytextwidth}
                                      \vspace{0.1cm}}
```

Parameters

#1: space width between two neighbor eps-images
#2: common column width
#3: common scale for three eps-images
#4: name of the left eps-image
#5: name of the middle eps-image
#6: name of the right eps-image
#1 × 2 + #2 × 3 = text width (default: 10.8 cm)

Three eps-images have different widths:

Definition

```
\newcommand{\epsTin}           [7]  {\vspace{0.3cm}
                                     \begin{columnsonlytextwidth}
                                     \columnright {#2}{\includegraphics #5}
                                     \columncenter{#1}{~}
                                     \hspace{-0.6cm}
                                     \columncenter{#3}{\includegraphics #6}
                                     \columncenter{#1}{~}
                                     \hspace{-0.6cm}
                                     \columnleft  {#4}{\includegraphics #7}
                                     \end{columnsonlytextwidth}
                                     \vspace{0.1cm}}
```

Parameters

#1: space width between two neighbor eps-images
#2: width of the left column
#3: width of the middle column
#4: width of the right column
#5: scale for and name of the left eps-image
#6: scale for and name of the middle eps-image
#7: scale for and name of the right eps-image
#1 × 2 + #2 + #3 + #4 = text width (default: 10.8 cm)
#5, #6, #7: [scale=..]{xxx.eps}

Note that because the number of parameters for one `\newcommand` can be maximum 9, the last three parameters must be written as such form: [scale=..]{xxx.eps}.

Examples

```
\epstin{0.6}{3.2}             {0.2}{Coma}                 {Hydra}                  {Perseus}

\epsTin{0.3}{3}{3}{4.2} {[scale=0.2]{Coma.eps}} {[scale=0.3]{Hydra.eps}} {[scale=0.2]{Perseus.eps}}
```

5.8 Using of the pdflatex command

When I used the `\pdflatex` command to typeset my files, I found a problem: although I used the `center` or the `flushright` environment, I always saw the pictures on the left of the column. The solution of this problem:

use the \hspace command to fix the position of each picture. For a frame of picture, I defined these three \newcommands for one, or two, or even three pictures on one row:

Definitions

```
\newcommand{\pdflatexpicframea}    [4]  {\hspace{#1 cm}
                                         \begin{minipage}{#2 cm}
                                         \hspace{-0.38cm}
                                         \picframe{#2}{#3}{#4}
                                         \end{minipage}}
```

```
\newcommand{\pdflatexpicframeb}    [4]  {\hspace{#1 cm}
                                         \begin{minipage}{#2 cm}
                                         \hspace{-0.77cm}
                                         \picframe{#2}{#3}{#4}
                                         \end{minipage}}
```

```
\newcommand{\pdflatexpicframec}    [4]  {\hspace{#1 cm}
                                         \begin{minipage}{#2 cm}
                                         \hspace{-1.28cm}
                                         \picframe{#2}{#3}{#4}
                                         \end{minipage}}
```

Parameters

#1: shift distance of this frame
#2: width of the frame
#3: height of the frame
#4: name of the frame

Example

```
\pdflatexpicframea{3.4}{4}{3}{dRdQ}
```

(Compare with the example of \picframe.) Note that if you just want to insert one picture, you can use this \pdflatexpicframea command. But, if you want to insert two pictures, you need to use the \pdflatexpicframea and \pdflatexpicframeb commands. (See the example for the \pgfuseimage command.) For three pictures, please combine the \pdflatexpicframea, the \pdflatexpicframeb, and \pdflatexpicframec commands. (See the example for the \includegraphics command.) For the \pgfuseimage command:

Definitions

```
\newcommand{\pdflateximageain}     [3]  {\hspace{#1 cm}
                                         \begin{minipage}{#2 cm}
                                         \hspace{-0.38cm}
                                         \pgfuseimage{#3}
                                         \end{minipage}}
```

```
\newcommand{\pdflateximagebin}     [3]  {\hspace{#1 cm}
                                         \begin{minipage}{#2 cm}
                                         \hspace{-0.77cm}
                                         \pgfuseimage{#3}
                                         \end{minipage}}
```

```
\newcommand{\pdflateximagecin}     [3]  {\hspace{#1 cm}
                                         \begin{minipage}{#2 cm}
                                         \hspace{-1.28cm}
                                         \pgfuseimage{#3}
                                         \end{minipage}}
```

Parameters

#1: shift distance of this frame
#2: width of the image
#3: name of the image

Example

```
\pdflateximageain{0.5}{5.5}{DAMA-4yrs}

\pdflateximagebin{0.8}{3.5}{DAMA-7yrs}
```

(Compare with the example of `\picDframe`.) Note that if you want to insert only one picture, you just need to use the `\pdflateximageain` command. (See the example for the `\picframe` command.) For three pictures, please combine the `\pdflateximageain`, the `\pdflateximagebin`, and `\pdflateximagecin` commands. (See the example for the `\includegraphics` command.) For the `\includegraphics` command:

Definitions

```
\newcommand{\pdflatexepsain}       [4]  {\hspace{#1 cm}
                                         \begin{minipage}{#2 cm}
                                         \hspace{-0.38cm}
                                         \includegraphics[scale=#3]{#4.eps}
                                         \end{minipage}}
```

```
\newcommand{\pdflatexepsbin}       [4]  {\hspace{#1 cm}
                                         \begin{minipage}{#2 cm}
                                         \hspace{-0.77cm}
                                         \includegraphics[scale=#3]{#4.eps}
                                         \end{minipage}}
```

```
\newcommand{\pdflatexepsecin}      [4]  {\hspace{#1 cm}
                                         \begin{minipage}{#2 cm}
                                         \hspace{-1.28cm}
                                         \includegraphics[scale=#3]{#4.eps}
                                         \end{minipage}}
```

Parameters

#1: shift distance of this frame
#2: width of the eps-image
#3: scale for the eps-image
#4: name of the eps-image

Example

```
\pdflatexepseain{0  }{3  }{3}{Coma   }

\pdflatexepsebin{0.3}{3  }{3}{Hydra  }

\pdflatexepsecin{0.3}{3.8}{3}{Perseus}
```

(Compare with the example of `\picTframe`.) Note that if you want to insert one eps-image, you just need to use the `\pdflatexepsain` command, (See the example for the `\picframe` command.) For two eps-images, you need the `\pdflatexepsain` and the `\pdflatexepsbin` commands. (See the example for the `\pgfuseimage` command.)

6 Miscellaneous

In this section I will give you some `\newcommand`s which I defined for some special aims, e.g. for this User's Guide. Due to their *non-generality* I *didn't* put them in the `CLShanCommands-Math.tex` and the `CLShanCommands-Beamer.tex` files. But I think the ideas are also interesting and very useful. Hence, I decided to put them here.

6.1 `\newcommand`s used in this User's Guide

I used some special `\newcommand`s for this User's Guide. I will give you *all of* my definitions and I think it is not difficult for you to find the corresponding examples (all of them?).

Definitions

```
\newcommand{\tabt}          [3]  {\begin{flushleft}
                                  \vspace{0.3cm}
                                  {\bf #1} \\
                                  \vspace{0.3cm}
                                  \renewcommand{\arraystretch}{#2}
                                  \begin{tabular}{#3}
                                  \hline}
```

```
\newcommand{\tabb}                {\hline
                                   \end{tabular}
                                   \vspace{0.3cm}
                                   \end{flushleft}}
```

```
\newcommand{\tabc}          [3]  {\tabb
                                   \vspace{-1cm}
                                   \tabt{#1}{#2}{#3}}
```

Here the "t", "b", and "c" stand for "top", "bottom", and "connect".

Definitions

```
\newcommand{\deft}                {\tabt{Definition} {1.8}{|p{4.5cm} p{0.5cm} p{10.7cm}|}}
\newcommand{\defst}               {\tabt{Definitions}{1.8}{|p{4.5cm} p{0.5cm} p{10.7cm}|}}
\newcommand{\defsc}               {\tabc{~}          {1.8}{|p{4.5cm} p{0.5cm} p{10.7cm}|}}
```

```
\newcommand{\defmat}              {\tabt{Definition} {1.3}{|p{4.5cm} p{0.5cm} p{10.7cm}|}}
\newcommand{\defmast}             {\tabt{Definitions}{1.3}{|p{4.5cm} p{0.5cm} p{10.7cm}|}}
\newcommand{\defmasc}             {\tabc{~}          {1.3}{|p{4.5cm} p{0.5cm} p{10.7cm}|}}
```

```
\newcommand{\defbmt}              {\tabt{Definition} {1.3}{|p{5.4cm} p{0.5cm} p{ 9.8cm}|}}
\newcommand{\defbmst}             {\tabt{Definitions}{1.3}{|p{5.4cm} p{0.5cm} p{ 9.8cm}|}}
\newcommand{\defbmsc}             {\tabc{~}          {1.3}{|p{5.4cm} p{0.5cm} p{ 9.8cm}|}}
```

Here "def", "ma", "bm", and "s" stand for "definition", "matrix", "beamer", and "-s" for plural of a noun.

Definitions

```
\newcommand{\ext}           [1]  {\tabt{Example} {#1}{|p{2.5cm} p{6cm}|}}
\newcommand{\exst}          [1]  {\tabt{Examples}{#1}{|p{2.5cm} p{6cm}|}}
\newcommand{\exsc}          [1]  {\tabc{~}       {#1}{|p{2.5cm} p{6cm}|}}
```

```
\newcommand{\exbmt}         [1]  {\tabt{Example} {#1}{|p{16.55cm}|}}
\newcommand{\exbmst}        [1]  {\tabt{Examples}{#1}{|p{16.55cm}|}}
\newcommand{\exbmsc}        [1]  {\tabc{~}       {#1}{|p{16.55cm}|}}
```

```
\newcommand{\parast}              {\tabt{Parameters}{1.3}{|p{8.925cm}|}}
```

```
\newcommand{\mast}                {\vspace{-1cm} \tabt{~}{1.1}{|p{5cm} p{3cm}|}}
\newcommand{\masc}                {              \tabc{~}{1.1}{|p{5cm} p{3cm}|}}
```

Here "ex" and "para" stand for "example" and "parameter".

Definitions

```
\newcommand{\fontt}        [1]  {               \tabt{\rm #1}{1.3}{|p{9cm} p{0.5cm} p{6.2cm}|}}
\newcommand{\fontc}        [1]  {\vspace{-0.5cm} \tabt{\rm #1}{1.3}{|p{9cm} p{0.5cm} p{6.2cm}|}}
```

Here "font" stands just for "font".

Definition

```
\newcommand{\mb}           [1]  {\makebox[2.5cm][c]{$\D #1 $}}
```

6.2 New fonts

Here I set all **\newfont**s which can be used and I also defined a set of **\newcommand**s in order to use some special symbols defined *only* in the font. Note that I didn't defined **\newcommand**s for all of the **\newfont**s. But I think it is not difficult for you to define a them when you need to use it.

6.2.1 Computer Modern Fonts: Upright and Inclined Fonts

Computer Modern Roman

```
\newfont{\cmrmx}      {cmr10}
\newfont{\cmrmxii}    {cmr12}
\newcommand{\cmrmsya}                              [1]  {{\cmrmx  \symbol{'#1}}}
\newcommand{\cmrmsyc}                              [1]  {{\cmrmxii\symbol{'#1}}}
```

Computer Modern Italics

```
\newfont{\cmitx}      {cmti10}
\newfont{\cmitxii}    {cmti12}
\newcommand{\cmitsya}                              [1]  {{\cmitx  \symbol{'#1}}}
\newcommand{\cmitsyc}                              [1]  {{\cmitxii\symbol{'#1}}}
```

Computer Modern Slanted Roman

```
\newfont{\cmslrmx}    {cmsl10}
\newfont{\cmslrmxii}  {cmsl12}
```

Computer Modern Upright Italics

```
\newfont{\cmupitx}    {cmu10}
\newfont{\cmupitxii}  {cmu10 scaled \magstep1}
```

Computer Modern Caps and Small Caps

```
\newfont{\cmcscx}     {cmcsc10}
\newfont{\cmcscxii}   {cmcsc10 scaled \magstep1}
\newcommand{\cmcscsya}                             [1]  {{\cmcscx  \symbol{'#1}}}
\newcommand{\cmcscsyc}                             [1]  {{\cmcscxii\symbol{'#1}}}
```

6.2.2 Computer Modern Fonts: Bold Fonts

Computer Modern Bold

```
\newfont{\cmbfx}      {cmb10}
\newfont{\cmbfxii}    {cmb10 scaled \magstep1}
```

Computer Modern Bold Roman

```
\newfont{\cmbfrmx}    {cmbx10}
\newfont{\cmbfrmxii}  {cmbx12}
```

Computer Modern Bold Italics

```
\newfont{\cmbfitx}    {cmbxti10}
\newfont{\cmbfitxii}  {cmbxti10 scaled \magstep1}
```

Computer Modern Slanted Roman

```
\newfont{\cmbfslrmx}  {cmbxsl10}
\newfont{\cmbfslrmxii}{cmbxsl10 scaled \magstep1}
```

6.2.3 Computer Modern Fonts: Typewriter Series

Computer Modern Typewriter

```
\newfont{\cmttx}      {cmtt10}
\newfont{\cmttxii}    {cmtt12}
\newcommand{\cmttsya}                              [1]  {{\cmttx  \symbol{'#1}}}
\newcommand{\cmttsyc}                              [1]  {{\cmttxii\symbol{'#1}}}
```

Computer Modern Italic Typewriter

```
\newfont{\cmitttx}    {cmitt10}
\newfont{\cmitttxii}  {cmitt10 scaled \magstep1}
```

Computer Modern Slanted Typewriter

```
\newfont{\cmslttx}    {cmsltt10}
\newfont{\cmslttxii}  {cmsltt10 scaled \magstep1}
```

Computer Modern Caps and Small Caps Typewriter

```
\newfont{\cmcscttx}   {cmtcsc10}
\newfont{\cmcscttxii} {cmtcsc10 scaled \magstep1}
```

Computer Modern Variable Typewriter

```
\newfont{\cmvttx}     {cmvtt10}
\newfont{\cmvttxii}   {cmvtt10 scaled \magstep1}
```

Computer Modern Typewriter Extension

```
\newfont{\cmttexx}    {cmtex10}
\newfont{\cmttexxii}  {cmtex10 scaled \magstep1}
\newcommand{\cmttexsya}                          [1]  {{\cmttexx  \symbol{'#1}}}
\newcommand{\cmttexsyc}                          [1]  {{\cmttexxii\symbol{'#1}}}
```

6.2.4 Computer Modern Fonts: Sans Serif Series

Computer Modern Sans Serif

```
\newfont{\cmsfx}      {cmss10}
\newfont{\cmsfxii}    {cmss12}
```

Computer Modern Slanted Sans Serif

```
\newfont{\cmslsfx}    {cmssi10}
\newfont{\cmslsfxii}  {cmssi12}
```

Computer Modern Bold Sans Serif

```
\newfont{\cmbfsfx}    {cmssbx10}
\newfont{\cmbfsfxii}  {cmssbx10 scaled \magstep1}
```

Computer Modern Semi-Bold Sans Serif

```
\newfont{\cmsbfsfx}   {cmssdc10}
\newfont{\cmsbfsfxii} {cmssdc10 scaled \magstep1}
```

Computer Modern Sans Serif Quotation

```
\newfont{\cmsfqviii}  {cmssq8}
```

Computer Modern Sans Serif Quotation inclined

```
\newfont{\cmsfqiviii} {cmssqi8}
```

6.2.5 Computer Modern Fonts: Other Letters

Computer Modern Dunhill

```
\newfont{\cmdunx}     {cmdunh10}
\newfont{\cmdunxii}   {cmdunh10 scaled \magstep1}
```

Computer Modern Funny Roman

```
\newfont{\cmfurmx}    {cmff10}
\newfont{\cmfurmxii}  {cmff10 scaled \magstep1}
```

Computer Modern Funny Italics

```
\newfont{\cmfuitx}    {cmfi10}
\newfont{\cmfuitxii}  {cmfi10 scaled \magstep1}
```

Computer Modern Fibnocci

```
\newfont{\cmfibviii}  {cmfib8}
```

6.2.6 Computer Modern Fonts: Mathematical Series

Computer Modern Mathematical Italics

```
\newfont{\cmmathitx}  {cmmi10}
\newfont{\cmmathitxii}{cmmi12}
\newcommand{\cmmathitsya}                          [1]  {{\cmmathitx  \symbol{'#1}}}
\newcommand{\cmmathitsyc}                          [1]  {{\cmmathitxii\symbol{'#1}}}
```

Computer Modern Mathematical Bold

```
\newfont{\cmmathbfx}  {cmmib10}
\newfont{\cmmathbfxii}{cmmib10 scaled \magstep1}
```

Computer Modern Symbols

```
\newfont{\cmsyx}      {cmsy10}
\newfont{\cmsyxii}    {cmsy10 scaled \magstep1}
```

Computer Modern Bold Symbols

```
\newfont{\cmbfsyx}    {cmbsy10}
\newfont{\cmbfsyxii}  {cmbsy10 scaled \magstep1}
```

6.2.7 AMS Mathematical Symbols

AMS Mathematical Symbol A

```
\newfont{\amssyax}    {msam10}
\newfont{\amssyaxii}  {msam10 scaled \magstep1}
\newcommand{\amssyaa}                              [1]  {\mbox{\amssyax  \symbol{'#1}}}
\newcommand{\amssyac}                              [1]  {\mbox{\amssyaxii\symbol{'#1}}}
```

AMS Mathematical Symbol B

```
\newfont{\amssybx}    {msbm10}
\newfont{\amssybxii}  {msbm10 scaled \magstep1}
\newcommand{\amssyba}                              [1]  {\mbox{\amssybx  \symbol{'#1}}}
\newcommand{\amssybc}                              [1]  {\mbox{\amssybxii\symbol{'#1}}}
```

6.2.8 AMS Euler Fonts

AMS Euler Roman

```
\newfont{\eurmx}      {eurm10}
\newfont{\eurmxii}    {eurm10 scaled \magstep1}
```

AMS Euler Bold Roman

```
\newfont{\eubfrmx}    {eurb10}
\newfont{\eubfrmxii}  {eurb10 scaled \magstep1}
```

AMS Euler Fraktur

```
\newfont{\eufrx}      {eufm10}
\newfont{\eufrxii}    {eufm10 scaled \magstep1}
```

AMS Euler Bold Fraktur

```
\newfont{\eubffrx}    {eufb10}
\newfont{\eubffrxii}  {eufb10 scaled \magstep1}
```

AMS Euler Scripts

```
\newfont{\euspx}      {eusm10}
\newfont{\euspxii}    {eusm10 scaled \magstep1}
```

AMS Euler Bold Scripts

```
\newfont{\eubfspx}    {eusb10}
\newfont{\eubfspxii}  {eusb10 scaled \magstep1}
```

6.2.9 Washington Cyrillic Fonts

Washington Cyrillic Roman

```
\newfont{\wncyrmx}    {wncyr10}
\newfont{\wncyrmxii}  {wncyr10 scaled \magstep1}
 \newcommand{\wncyrmsya}                          [1]  {{\wncyrmx  \symbol{'#1}}}
\newcommand{\wncyrmsyc}                           [1]  {{\wncyrmxii\symbol{'#1}}}
```

Washington Cyrillic Bold

```
\newfont{\wncybfx}    {wncyb10}
\newfont{\wncybfxii}  {wncyb10 scaled \magstep1}
```

Washington Cyrillic Italics

```
\newfont{\wncyitx}    {wncyi10}
\newfont{\wncyitxii}  {wncyi10 scaled \magstep1}
```

Washington Cyrillic Sans Serif

```
\newfont{\wncysfx}    {wncyss10}
\newfont{\wncysfxii}  {wncyss10 scaled \magstep1}
```

Washington Cyrillic Caps and Small Caps

```
\newfont{\wncyscx}    {wncysc10}
\newfont{\wncyscxii}  {wncysc10 scaled \magstep1}
```

6.3 \ignore and \switch

If you typed a long text but don't want to use for a while, you can use a % or even lots of % to set this paragraph as a comment. But it is certainly a better idea to use a command such like `\ignore` to let the typeset-program *ignore* this text. Then you can save pretty much time in which you type and delete the %s.

Definition

```
\def \ignore#1 {}
```

Note that, first, it is necessary to use the `\def` command for this aim. You can not use a command such like `\newcommand{\ignore}[1]{}`. Because You want to send something (as the parameter #1) to nothing, and if you use the command `\newcommand{\ignore}[1]{}`, *nothing* has been defined as the parameter #1. Then the typeset-program will send an error massage to you... Second, if you have some bugs in the text (for example, a `}` more), you can not use this `\ignore` command! Because your typeset-program can not find the corresponding `}` for the `\ignore{`. On the other hand, you could need to change something from two or more choices. For example, I prepared my three talks with students of different levels at once. Hence I gave different titles for the same context. Or, when I wrote the text of my slides, I had to use the `\picframe` command instead of the `\imagein` in order to protect my old notebook... I can write two choices of one section title one after the other and use the % to pick up the other one which I want to use every time. But, it is for sure better to define a command such like

Definition

```
\newcommand{\switch}       [2]  {#1}
```

Then I just need to change the number of the parameter (#1, #2, or even #3) in my preamble, I can change all of the alternative parts at once.

Acknowledgement

Here I want to thank Markus Bernhardt, my German colleague in the Physikalisches Institut der Universität Bonn, for the new idea and interesting challenge for the `\eliminate` and `\equalto` commands defined in Section 2.14.